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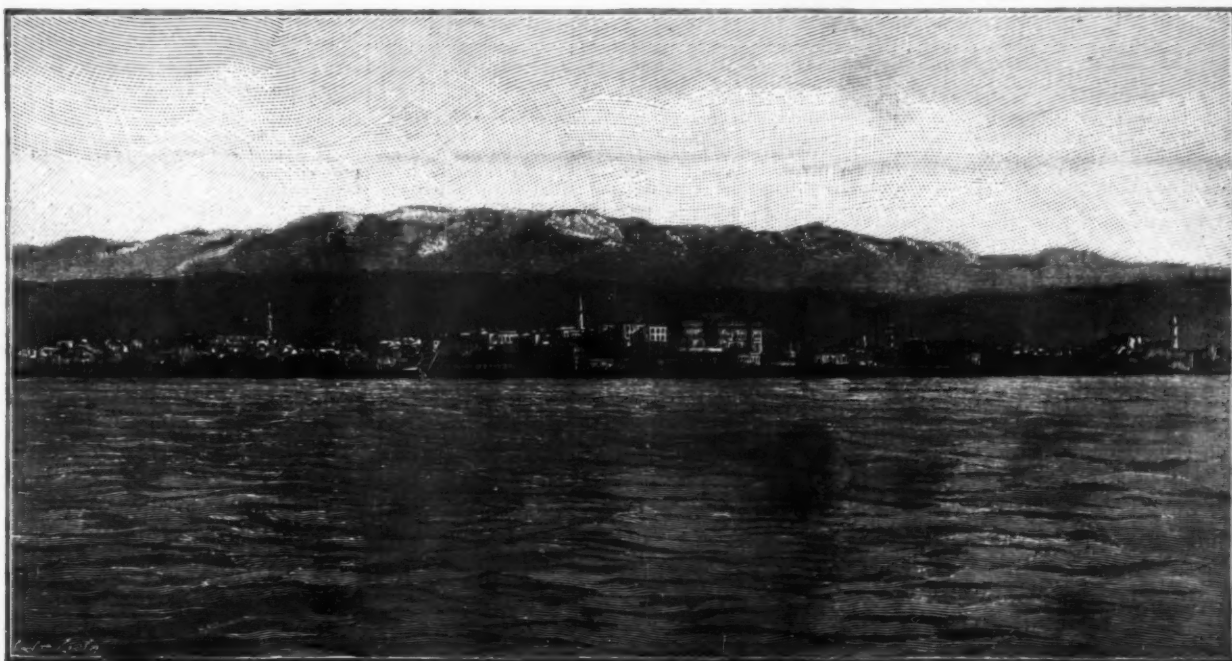
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THE TROUBLE IN CRETE.

CRETE, or Candia, one of the largest islands of the Mediterranean, is almost the most southerly portion of Europe. It is 90 miles from Cape Malea, in the Peloponnese, and its northeast angle is distant only about

varied outline, with rugged and lofty promontories. Though so large a part of the island is occupied by mountains, the rest of the island is of great fertility, and under a stable government would no doubt prove to be one of the most fertile and productive islands of the Mediterranean. The cypress and the olive are

so that in time it was called "the island of Candia," a name which still sticks to the island. The government of Crete by the Venetians was very arbitrary, and many insurrections resulted, but, on the whole, the country prospered. In 1645 the Turks landed with 50,000 men and speedily reduced Candia. Retimo fell in 1645, and



THE ISLAND OF CRETE—VIEW OF CANEA.

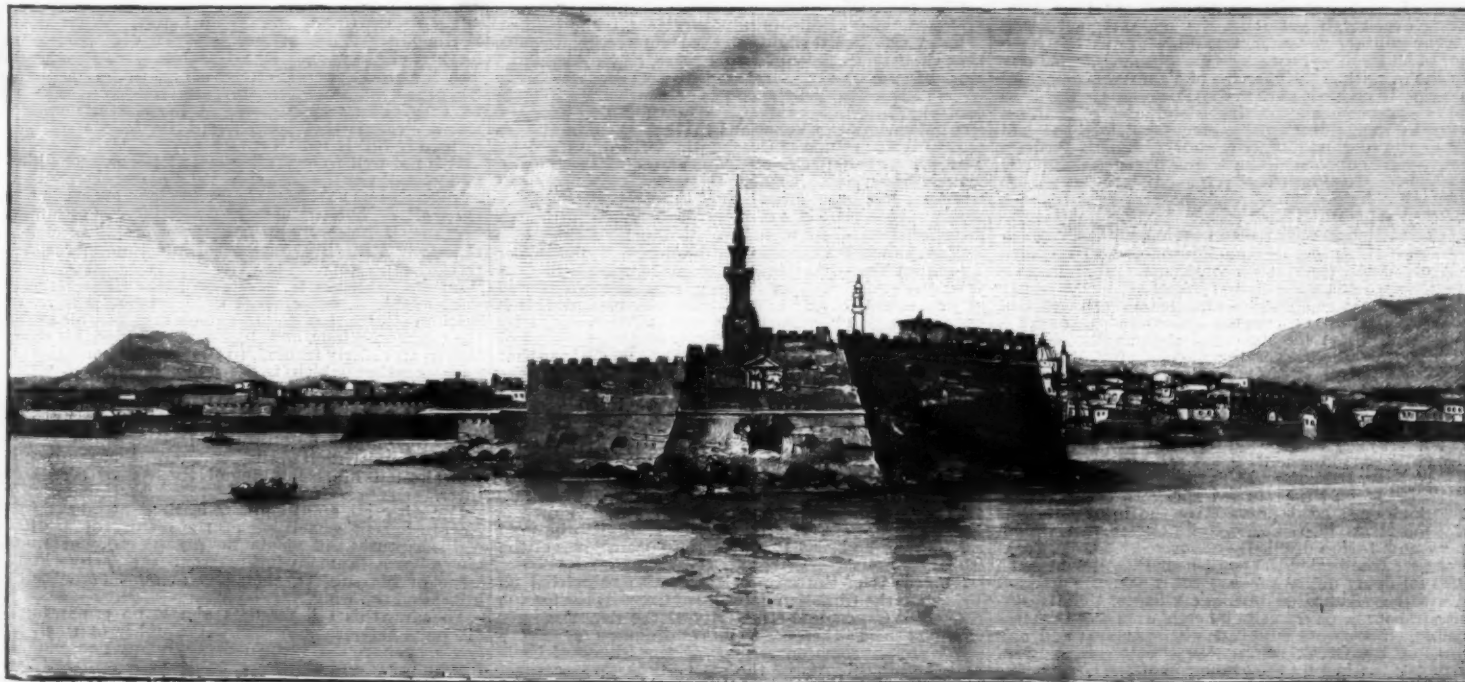
110 miles from Cape Krid, in Asia Minor. The island is 160 miles in length and its breadth is nowhere greater than 35 miles, and in some places it narrows to 10 or 12 miles. The larger part of the island is occupied by ranges of mountains, some of which are of very considerable height. Mount Ida, near the center of the island, is 8,000 feet in height. Other mountains are almost equally high. Much of the country consists of arable plains. A characteristic feature of Crete is the occurrence of depressed valleys or basins at considerable height above the sea. From its peculiar formation it naturally results that Crete contains no rivers of moment. In consequence of its mountainous character, the coast line of Crete presents a very broken and

largely found; oranges and lemons are abundant. Tobacco and cotton grow well, but are not cultivated to any extent. Centuries ago the wines of Crete were celebrated, but they no longer enjoy their former reputation.

The early history of Crete, as of Greece, is mixed up with mythology, and its history does not call for special attention until the thirteenth century is reached. In the partition of the Greek empire, after the capture of Constantinople by the Latins in 1204, Crete fell to the lot of Boniface, Marquis of Montserrat, who sold the island to the Venetians, who held it for more than four centuries. Under the Venetians, Candia, a fortress built by the Saracens, became the seat of government,

in 1648 they laid siege to the capital—Candia. Now began the longest siege on record. It held out until 1669. The whole island then became subject to the Turks and was badly governed. In 1821 a revolution broke out and the Turks were driven to the fortified cities, and in 1830 the allied powers transferred Crete to the government of Mehemet Ali, Viceroy of Egypt. In 1840 Crete was taken from Mehemet Ali and replaced under the dominion of the Turks. In 1865 the population of Crete was estimated to be 210,000.

Ever since the last civil war, which lasted from 1867 to 1869, insurrections in Crete have been the order of the day. The Turkish troops spread terror through the towns and the natives did not hesitate to retaliate.



VIEW OF CANDIA, CAPITAL OF THE ISLAND OF CRETE.

Early in the year the old religious hatred (not race hatred; Christians and Mohammedans belong to the same race) began to show itself and in the spring there was open revolt. The Christians are striving for something better than they have had—order, uprightness, doing away with barbaric conditions, and above all autonomy. It would seem that such things could be easily attained, for they would be for the good of those in power as well as of the natives, but the Turks feared that it would lead to entire independence, and therefore refused to consider the requests of the natives. If the authorities are somewhat less rigid to-day, the change is due partly to the rapid decline of Turkish sovereignty and partly to the pressure of the European powers, who are less troubled about the people of the Orient than by the fear that local complications may completely unsettle existing Oriental conditions.

The insurrection was centered in the western part of the island, and especially in the town of Canea and its suburbs. Early in April street fights became frequent, and the European consuls heard that the Mohammedans forced their way into the houses of Christians. The various consuls had difficulty in protecting their fellow countrymen, and so they asked for war ships, which came and anchored in the harbor of Suda, and in the meantime the Porte called the Assembly. But the struggle continued and the number of insurgents gradually increased until it reached about 5,000 men, about 2,000 of whom shut up the Turkish garrison at Vamos, while the Sphakiotians descended from their mountains and gave the Turkish troops plenty to do, but as they did not dare to "take the bull by the horns," the uplands of Sphakia were not molested. In the meantime the Porte was unwise enough to introduce a military element that seemed well suited to inflame the passions of the natives. We refer to the Benghazi, irregular soldiers from Tripoli. The occasional murder of a Bashi-bazouk gave the signal for a horrible massacre, which took place in spite of the arrival of the war vessels. The insurrection now moved eastward; in Candia and Rethymnon there were street fights, Christian villages were destroyed and the Turkish detachments were massacred by the insurgents.



A CANDIAN TYPE.

Turkhan Pasha, who was then governor-general of the island, could not restrain the military from committing excesses, because he was not on good terms with the military governor, Izzedin, who was the instigator of all the bloody work.

In the meantime the garrison of Vamos was more and more closely pressed, so that the Porte was obliged to send re-enforcements to the island and to make a change in the military management. Before the end of May the new military governor, Abdullah Pasha—whose selection proved to be a great mistake—arrived in Canea. The insurgents immediately turned to Athens for help. The Greek government remonstrated, the consuls raised their warning voices, the Porte tried to bargain here and there, and the Turkish authorities did not know where they stood. The plundering of Christian villages continued, and thousands of fugitive women and children collected on the northern coast desiring to be taken to Greece. In spite of the increased military force the Epitropie (the committee of the insurgents) had control of the entire district of Apokorona and part of the district of Rethymnon, but bands of a secret Mohammedan committee acted as a counterpoise there. The districts of Kissamo, Kydonia, Selino, and to a certain extent, Sphakia, were in a disturbed condition though not in open rebellion; and the eastern portion of the island was not affected by the movement.

In the latter part of May the troops gained their first tangible victory; they released the garrison of Vamos, which had been hard pressed by the insurgents, but now marched into Canea unmolested. Abdullah Pasha now took a decidedly offensive stand. A Turkish cruiser bombarded the coast near Pukolles on June 8, and for many nights passing ships saw the horizon red with the flames of burning villages. The insurgents, of course, paid in similar coin wherever that was possible. They were supplied with weapons and ammunition by Greek sailing vessels, the landing of which was favored by the formation of the coast. The Epitropie, which had its seat of government in Stilos, was constantly gaining adherents, and the Porte, con-

tinually urged by the powers to make an end of this condition of things, but moving at its usual snail's pace, finally condescended to indicate its willingness to make some concessions. Before the end of June the incompetent civil governor, Turkhan Pasha, was recalled, and his place was filled by the Prince of Samos, Georgi Pasha Berowitsch, and further, the Sultan promised that upon the opening of the Assembly, which was set for June 29, a universal amnesty should be proclaimed. The treaty of Aleppo was to form the basis of a settlement, but the insurgents declared that this treaty, which had been satisfactory to the leaders at the time it was framed, 1878, after the Berlin Congress, was now inadequate.

The treaty of Aleppo required, among other things, that the civil governor of the island should be a Christian—since the Christians greatly predominated among the inhabitants—that the chief men of each district should belong to the religion which prevailed therein, and that half of the revenue should be expended in public works on the island. The armed national assembly demanded more; that the post of military commander should be done away with, the civil governor should be given increased power, military as well as civil power, and the customs should be reformed. A more radical party had already adopted the Greek colors and was encouraged by the arrival of country people with weapons and provisions. It is said that the men on two ships belonging to this party massacred the crew of a Turkish torpedo boat. Early in July the revolutionists assembled, declared for union with Greece and formed a provisional government.

The pressure of the powers was now brought to bear on the insurgents and they were informed that, in consideration of the advances made by the Porte, they would forfeit all claim to the sympathy of Europe if they did not immediately come to terms. The Greek government also recognized the fact that a check must be given to such radicalism. Finally the national assembly was brought to a standstill. In the middle of July twenty-five Christian and twenty-two Mohammedan deputies appeared and the Porte gave Abdullah Pasha strict orders to suspend all hostile demonstra-



TURK OF CRETE.

tions unless the troops were attacked. In the first session there were protests of all kinds, and there was no cessation of skirmishing and massacres on both sides.

From a historical standpoint it is interesting to note that Crete never belonged to Greece, and even at the time of the Doric invasion was not predominantly Greek. It withstood the efforts of the Turks to gain control of it for a long time, and until 1669 it was the last bulwark of the Venetians in the Orient and consequently the refuge of Greeks who were oppressed by Turkey. It is only since the awakening of national principles that Candia, which is Greek through and through, has been drawn to Greece, which suddenly seems to take the place of a mother country although it never has been so in reality. To the far sighted end of the whole affair cannot be doubtful, says Uber Land und Meer, the tricolor flag of Greece will float from the ruined walls of the old Venetian town as well as from other islands in the archipelago, and this is only a question of time which will be determined by the approaching fall of the Turkish empire.

A dispatch from Athens dated August 24 says that the Porte has signified its willingness to accept the terms of the proposal for the settlement of the Cretan troubles, which originated with Count Goluchowski, Austrian Minister of Foreign Affairs.

The proposal is that Turkey grant to Crete a new constitution, the main features of which are the appointment of a Christian governor and the establishment of Cretan autonomy, with the payment of tribute to the Sultan under the general guarantee of the European powers, the amount of tribute to be paid annually to be based upon the ratio of revenues of the island.

The terms of the proposal were also submitted on Friday to the Christian deputies of Crete by the foreign consuls at Canea, and a majority of the deputies have signified their adherence to its conditions.

We present some engravings of the island of Crete and the inhabitants of the same. For these engravings we are indebted to L'illustrazione Italiana and Uber Land und Meer.

THE YOUNG ENTOMOLOGIST AND WHAT HE WANTS.

By SAMUEL H. SCUDDER.

It is a mistake to suppose that a boy in whom the passion for hunting and collecting insects is just beginning to appear requires any great array of books and implements to carry out his wishes. The books are few, the implements cheap. It will, indeed, be a difficulty not easily overcome to find out the names of his captures; but this is what adds zest to his employment; and however far he may carry his studies, even if to the maturity of the professional naturalist, the difficulty will ever bring its perplexities and its incentives.

I never knew a boy to begin his interest in entomology by merely watching the habits and lives of insects. His first passion is to catch them, see what they look like, and how many kinds he can obtain. This appears to be the natural way; and it is better not to attempt to disturb or alter it, though the study of the histories of insects has a far deeper intrinsic interest, and opens the door to a much vaster and more instructive field.

First, then, the boy must have a net. Any kind may be made to serve; but the best for permanent and all-round use is a bag fastened to a ring, to which a handle may be attached. Get a piece of galvanized iron wire four feet long, a brass ferrule, or tube, five inches long and three-quarters of an inch in diameter, and a light, round, wooden stick of the same diameter and three or four feet long. Bend two and a half inches of each end of the wire at right angles in the same direction and, curving the wire to form a circle, drop the ends into the ferrule, fix them securely by a plug of hard wood, filling one-half the ferrule; whittle the stick so as to insert it snugly in the other end, and the frame of the net is made. The best material for the bag is "double bobbinet;" it should be attached to the ring by a strong linen or cotton band, taper regularly to a rounded bottom without corners or pockets, and be about thirty inches long, so as to double over the ring with a few inches to spare.

One soon learns to capture even the liveliest insect with a dexterous turn of the net, and experience is the only needed guide; in general, strategy is better than chase. The net is doubled so as to prevent escape of the captive, and the insect transferred to a wide-mouthed pocket bottle by carefully inserting the uncorked bottle into the net neck foremost and corking it after the insect is secured therein. If the boy is old enough to thoroughly understand the need of caution, he may use a "cyanid bottle," made by pouring a little plaster of Paris over a small lump of cyanid of potassium; but this is a deadly poison, and it is better to begin by using a bottle with a bit of sponge attached to the cork which may be wet with chloroform; as this evaporates rapidly, it needs frequent wetting. Insects killed by either of these methods appear to suffer no pain, and death is very quick, or stupefaction rather, for, unless kept a little while under the influence of the drugs, the supposed dead insect will survive.

There only remains the proper display of the specimen and its care. For this, pins, setting boards and boxes are necessary. Ordinary pins should not be used, as they are too short and stout; insect pins can be obtained of the taxidermists and dealers in natural history supplies, and come in various sizes. Klaeger's are the best. Only a few of assorted sizes should be bought at first, to find which are most needed. Most insects should be pinned through the thorax or middle of the body, and placed high on the pin; but beetles and orthopterous insects (grasshoppers, cockroaches, etc.) should be pinned through the right wing cover near the base.

Setting boards are any contrivance for holding the wings of an insect expanded until they dry. A strip of smooth wood, with a deep groove for the body, answers the purpose, if the groove be deep enough also to receive a bit of cork or pith through which the pin may pass far enough. The wings are then carefully stretched upon the board by needles, and kept in place by slips of pinned card or of glass. Here they should be kept for a fortnight.

For boxes it is best at first to use simple pine wood boxes, carefully and tightly made, about 9x14 inches in size, and deep enough to receive insects both at top and bottom. They will always be useful even when discarded for something better. The top and bottom of the box should be lined with sheet cork, having paper pasted over it to cover all cracks and give it a neat appearance. It is best to keep a "naphtha cone" (obtainable at the taxidermist's) in each box to keep out museum pests. A better and more permanent case is the glass covered Deyrolle drawer, described in full in my "Butterflies."

It is not well to begin with many books. The kinds of insects known and named in any district are to be numbered by the thousands, and no one book describes them all, or, indeed, many of them. It should suffice a beginner if he can name a very few of his specimens, especially if he lives where there are no libraries or public collections. The best single book is Harris' "Insects Injurious to Vegetation," the illustrated edition, which is, indeed, the only edition now in the market. With that he can name a considerable part of the common kinds, and by its aid arrange his collection in an orderly fashion, so that similar sorts shall be near together, which is the aim of all classifications. It will also give the boy a clew to the life histories of many of his finds, to which he should now turn his attention. If the boy begin with butterflies—as very many do—he will find fuller aid, though without pictures, in my "Guide to the Common Butterflies," which will also tell him something of the lives of these creatures.

For, after all, an attempt to learn at first hand from Nature herself something of the history of the lives of his captures will yield a far greater enjoyment, and give a boy a far more intimate and satisfactory knowledge of his subject, than any amount of collecting insects on the wing.

To carry this out requires almost no apparatus at all, only patience and skill. A number of small tin boxes, such as are thrown away in any household, a few tumblers and old boxes, and some sort of an aquarium, if only a bowl, are all the requisites. Imitate as closely as possible the natural conditions under which

a grub or caterpillar lives, keep it supplied with fresh food from the plant on which it is found, carefully see that its surroundings are as clean as possible, and nearly everything can be raised to maturity; and, what is more, the full-fledged insects obtained in this way make far better "specimens" than any which can be captured upon the wing.

Or, if the boy is keen sighted and patient, he may discover an insect laying eggs upon a plant, and then he may obtain the entire story of its life; for the young will always feed upon the plant on which the mother has laid her eggs, and many insects may be induced to lay eggs by confining them in a muslin bag or a box upon the growing plant. The discovery of the life history then depends upon the care of the breeder.

Here, too, is a distinct opportunity to add directly to our stock of positive knowledge, for of the myriads of insects that live about us the life histories of relatively few are known, of almost none are fully known. As the boy becomes more expert, therefore, he should keep a book in which should be recorded all the changes that occur in his feeding flock. Each kind should be given a distinctive number, to be attached to the box in which it is kept and duly entered in the book, to be changed to a name only when the mature insect appears and can be identified.

Then the boy will begin to taste some of the pleasures and anxieties of the naturalist bent on extorting some of the secrets of nature still hidden from knowledge. By correspondence with others or by excursions to distant places he may bring home new trophies and find new problems to solve. The whole method is so simple! Here on my desk as I write are two little round and flat tin boxes, two and three inches in diameter respectively, one containing a few wild violet leaves, the other some blades of common grass. Each contains a number of caterpillars of rare northern butterflies that flourish in such regions as Labrador, one kind feeding on violets, the other on grass or sedge, the full history of each of which remains to be written, of one is wholly unknown. The eggs from which they hatched were obtained from the living mother by a kind Canadian friend, who simply shut the butterflies up with growing violets and grass and then sent me the eggs by mail. There was no duty on them! I change the food and clean the boxes daily—a matter of a few minutes only. By and by I shall give them roomier quarters in tumbler covered with glass. When they grow still larger I shall transfer them to plants growing in pots I have already prepared for them and cover them with a wire screen. Thus they are kept within bounds and I free from outside harm; and one of these days I shall hope to know more of the story of their lives than has yet been recorded, be able to compare them at any stage with their allies in more hospitable regions, and discover, perhaps, some of the makeshifts they employ to hold their own in the struggle for existence in the colder latitudes they call their home.—The Independent.

THE ECLIPSE OF THE SUN.

An interesting description of the scene in the neighborhood of Vadsø appeared in the London Times of August 10 and the following is an abridgment of it.

On Sunday morning the Varanger Fjord in the north-east of Norway presented a scene which has probably never before been equaled in a latitude of 70°. The anchorage at the port of Vadsø was crowded with men-of-war, yachts, and passenger steamers, brought together by reason of the total solar eclipse. For several days the numerous astronomers on the ships have been engaged in landing their delicate and elaborate instruments, and transporting them to the beautiful sites which here abound.

By last night the laborious preparations of the different observing parties had been completed, and they awaited with what composure they might the momentous events of the morrow. In any circumstances an Arctic summer night, where broad daylight reigns throughout, is very different from a night in a temperate region. But on this occasion there were so many interruptions, partly by the arrival of friends in the various ships, that rest was but little thought of, and indeed from two to five and even earlier a succession of boats brought hundreds of passengers from the ships to the shore.

The fence which marked out the ground occupied by the observers was guarded by bluejackets, charged with the duty of keeping at a suitable distance the groups of picturesquely clad Finns and Lapps, who gazed with astonishment on the strangers who had traveled so far, and on the wonderful appliances they had brought with them. Many of these Arctic inhabitants were, however, sufficiently sophisticated to be provided with the traditional pieces of smoked glass with which to make their own observations.

The sun could not be seen at the moment when the moon first made contact, though almost immediately afterward it was visible with a slight encroachment on the brilliant edge, showing that the eclipse had commenced. For nearly an hour hope and fear then alternated. Everything, of course, depended on the condition of the sky at the moment of totality, and it was hoped that some of the characteristic phenomena of a total eclipse might be presented. This hope was strengthened as the crescent sun waned thinner and thinner and still remained visible.

As the supreme moment of totality approached, the broad landscape sensibly darkened, and the flood became more gloomy. It was as if some mighty thunder shower was about to descend; but, alas! the clouds again thickened, and the observation of the moment of actual totality, if effective at all, could only be made by glimpses with a telescope through a very dense medium. Some observers were, of course, constrained to limit their attention to their instruments, and to the sole discharge of the duties which had been intrusted to them. But many were in the position of being able to look at the sun until the crescent of light was about to disappear, and then face round to the opposite point of the horizon. The object of this maneuver was to permit the observer to see the impressive spectacle of the advance of the lunar shadow over the earth.

The situation at Vadsø lent itself admirably to the observation of this magnificent phenomenon. As the shadow advanced across the fjord, it enveloped the training squadron as it lay at anchor, the details of the ships' rigging disappeared from view and their lights gleamed forth brilliantly. Still the shadow pressed on

with its majestic speed of a mile in every couple of seconds. It moved as swiftly as a cannon ball until it reached the observers at Vadsø, and then announced to them in the most impressive manner that the supreme moment of their visit had arrived, and that totality was complete.

The darkness that then buried Vadsø and its numerous observers lasted for a minute and forty seconds. The unwonted spectacle hushed every one to silence. A few startled birds hurried past the camp, and amid the canopy of cloud which covered the heavens at least one observer desisted a star. But, though all the visitors felt that the magnificent phenomena were worthy of being remembered as a life-long experience, yet it is none the less true that, from a scientific point of view, the result of all the labors at Vadsø was hardly anything.

The object of the astronomers, who erected at such vast pains great photographic instruments, was to depict the corona and to analyze with spectroscopes the light which it dispenses. It is true that during the time of totality they exposed their plates in accordance with the careful drill and organization which were indispensable if full advantage was to be taken of the brief period. But, unfortunately, during the time of totality the clouds were obdurate, and nothing could be seen.

The 100 seconds fled, marked only by the mechanical precision of the officer who counted them aloud. The light around them was not greater than that during a full moon, but in the distance mountain tops could be discerned which were not in the shadow and were shining brilliantly.

At last the darkness lifted, and the manner in which the light returned was almost startling in its suddenness. It was not that the sun became visible—this, indeed, did not at first happen—but when the moon had passed by, and when totality was over, the sun illumined the clouds, and this gave again the usual light of cloudy day when the orb itself is invisible. A few seconds later a glimpse was afforded of the crescent form of the sun, and then the clouds closed in once more, and did not withdraw until long after the moon had passed away from the disk.

THE EMBLEMATIC USE OF THE TREE IN THE DAKOTAN GROUP.*

By ALICE C. FLETCHER.

The tribes of the Dakotan or Siouan linguistic stock aggregate in number about 45,000 Indians. Grouped according to a close relationship of language, we find in the United States: 32,000 in the Dakota; 4,000 in the Omaha, Ponka, Quapa, Kanza and Osage; 800 in the Iowa, Otoe and Missouri; 2,200 in the Winnebago; and 3,000 in the Hidatsa, Mandan and Crow tribes. The remaining 3,000 are widely scattered, with the greater part living in the Provinces of Canada.

At the beginning of the seventeenth century, a number of tribes belonging to this stock dwelt on a strip of the Atlantic coast, now within the limits of North and South Carolina, extending as far west as the Alleghenies, and north to the Maryland line, and controlling the headwaters of the streams flowing westward. They were in constant warfare with their Algonquian and Iroquoian neighbors, and were exterminated as tribes within the historic period. The majority of the Siouan Indians were already beyond the Mississippi, where they were met by early explorers, and where they now dwell. We find the purport of their traditions to be that they were slowly driven from their eastern home by implacable enemies; and that once beyond the Mississippi, they spread to the northern tributaries of the Missouri, westward to the Rocky Mountains and south to the Gulf of Mexico, where recent investigations have brought to light a remnant of the Biloxi.

Contact with Algonquian, Iroquoian, Muskogean, Caddoan and Kiowan stocks, during the period of progress over this vast tract of country, has left its traces in the Siouan rites and customs; but the uncertainty that still clouds the past history of this people makes it difficult to determine when certain rites were adopted, or to gauge with accuracy the modifying influences of other stocks upon native usages and beliefs. From the scant records left by early travelers, with the fragmentary nature of the information still obtainable from the few scattered survivors of the eastern and southern tribes, a full reconstruction of their social and religious customs is impossible; but enough can be discerned to indicate that the eastern, southern and western tribes were all under the influence of cults which seem to have been fundamentally the same.

In this paper is offered a slight contribution to the early history of social and religious development, inasmuch as in tracing the emblematic use of the tree in the Siouan linguistic group, we follow a people from a comparatively primitive condition, living in isolated bands, independently of each other, to their organization within the tribal structure, compacted by the force of common religious beliefs.

That ideas are the ruling force and "the constructive center" of human society, is readily conceded as applicable to our own race. It is equally true of the Indian; but, in according this power to ideas, the modifying influence of environment is not to be overlooked. One cannot conceive of man apart from environment, his contact with it is the very condition of being. As Herbert Spencer has phrased it, life is "the continuous adjustment of inner relations to outer relations."

This "adjustment" of man to his environment is the work solely of ideas, and the process, as evinced in this group of Indians, goes to show that those ideas which have formed "the constructive center" of the tribe are religious ideas.

Indian religions seem to have been subject to the same laws that governed the development and growth of religions on the eastern continent. There, we know the several systems to have been begun with the simple utterances of a seer, which, as they were passed from mouth to mouth, became more and more clouded with interpretations, gradually expanded in detail, and finally formulated into ceremonials with attendant explanatory and dramatic rites. As time rolled into centuries, these ceremonies, with their accessory priests, came to be regarded as of supernatural origin, endowed with superhuman power, and authorized to exercise

control over the affairs of the tribe or nation; but the one living germ within the ponderous incrustation of doctrine and ceremony, that had accumulated throughout the ages, was still the surviving, vitalizing thought of the seer.

Turning to America, to the group of Indians of our especial study, we find traces of a similar history; for, penetrating beneath the varied forms of their religious rites, we come upon a few fundamental conceptions or thoughts, the most dominant of which perhaps is the idea of the all-permeating presence of what we call life, and that this life is the same in kind, animating all natural forms and objects alike with man himself. Co-ordinate with this idea, which has received the name of animism, is that of the continuity of life, that whatever has once been endowed with it, must continue to be a recipient of it; in other words, whatever has once lived must continue to live.

There is no reason to think that at any time in the past, it was possible for the idea of animism, or for any other idea, to have fallen into the mind of every savage simultaneously, as a cloudburst drenches the plain. Ideas have ever made their way as they do now, slowly and by being communicated and talked over. The idea of animism is a very remarkable one. It has been so built into the mind of the race that it is difficult to imagine a time when it was not; and yet there was such a time, a time when man stood dumbly wondering at the birds and beasts, assailed like himself by hunger, and finding food from the same supply; at the alternation of day and night; and at the destructive and vivifying effects of the storm. But these wondering observations were like so many disconnected fragments until some thoughtful mind caught the clue that led to the bold and clarifying thought, that all things were animated by a common life, and that man was not alone upon the earth with strange and alien creatures, but was surrounded by forms replete with life like his own, and therefore of his kindred.

This mysterious power or permeating life was called in the language of the Omaha and Ponka tribes, Wa-kan-da. This word is now used to designate the Deity. The original meaning, while conveying the idea of the mysterious, something hidden or unseen, also implied the power to bring to pass. Wa-kan-da-gi, an adverbial form of the word, is applied to the first putting forth of a new faculty, as when a child first walks or talks, but the word wa-kan-da-gi would not be used to express the resumption of faculties lost by sickness or accident.

Fourteen years ago, while sitting with me in his tent, a thoughtful old Dakota Indian, who had never come under missionary influence, spoke of his native religion, in which he was a firm believer. He explained the teaching of his fathers, and tried to make me understand that the mysterious power which animates all things, is always moving and filling the earth and sky. He said: "Every thing as it moves, now and then, here and there, makes stops. The bird, as it flies, stops at one place to rest in its flight, and at another to build its nest. A man when he goes forth stops when he wills, so the mysterious power has stopped. The sun, the moon, the four directions, the trees, the animals, all mark where it has stopped. The Indian thinks of all these places, . . . and sends his prayers to reach the mysterious power where it has stopped."

This Indian had evidently been taught that the power pervading all things was one in kind, and possessed of a quality similar to the will power of man. He said: "A man when he goes forth, stops when he wills; so the mysterious power has stopped."

The Indian conceives of Wa-kan-da as endowed with like, though greater powers than those possessed by man. The prayer chanted by every Omaha when he goes out to fast, seeking a vision:

"Wa-kan-da dhe-dhu wa-pa-dhin a-tan-he."

Wa-kan-da here neatly I stand, is an appeal to something that is believed to be capable of understanding the needs of a man, and implies a conception of Wa-kan-da that is anthropomorphic. But the Indian does not apparently think of Wa-kan-da as apart from, or outside of nature, but rather as permeating it, and thus it is that to him all things become anthropomorphized.

In a Ponka ritual the following address is made to the tree, as represented in the framework of the lodge in which the ceremony takes place:

"Oh! Thou Pole of the Tent, Ethka;
"Along the banks of the streams, Ethka;
"With head drooping over, there Thou sittest, Ethka;
"Thy topmost branches, Ethka;
"Dipping again and again, in very truth, the water, Ethka;

"Thou Pole of the Tent, Ethka; (The Tree now speaks)

"One of these little ones, Ethka; (That is, the suppliant)

"I shall set upon one (one of my branches), Ethka;

"The impurities, Ethka;

"All I shall wash away, Ethka."

The tree is supposed to take the man on its branches, as in one's arms, and dip him in the stream, where "all within the body" is "cleansed."

Long life is desired, and the Rock is invoked:

"Oh! Aged One! Ethka;

"Thou sittest as though longing for something, Ethka;

"Thou sittest like one with wrinkled loins, Ethka;

"Thou sittest like one with furrowed brow, Ethka;

"Thou sittest like one with flabby arms, Ethka." (The Rock now speaks.)

"The little ones (the people) shall be as I am, whoso-

ever shall pray to me properly" (i. e. ceremonially).

Many other illustrations could be given to show the Siouan Indian's anthropomorphic conception of nature.

With the acceptance of the idea that all things were quickened with the same life, came the belief that a mysterious relationship existed between man and his surroundings, and it naturally followed that, in his struggle for food and safety, he should seek to supplement his own strength by appealing to his kindred throughout nature; should "send his prayers to reach the mysterious power where it has stopped." Said a venerable Indian to me one day: "The tree is like a human being, for it has life and grows; so we pray to it, and put our offerings on it, that the mysterious power may help us."

Co-ordinated with these ideas concerning nature, was that of the continuity of life, which could not but lead to a belief in dual worlds with interchanging relations:

* Paper read before the Section of Anthropology, American Association for the Advancement of Science, at the Buffalo meeting, August, 1896.

thus, we find that these Indians were firmly convinced that the dead camp in the unseen world, as they did while upon earth, each gens having the same relative place in the tribal circle, and each person at death going to his own gens.

Among the Ponkas the Ta-ha-u-ton-a-zhi division of the Ni-ka-pa-shna gens, whose totem is the deer, put deer skin moccasins upon their dead, that they may be recognized by their kindred, and not lose their way in the other world. Among the Otoes, when an Indian dies, his face is painted in a manner peculiar to his gens, by one having the hereditary right to perform this act, who says to the dead: "In life you were with those you have now left behind. Go forward! Do not look back! You have met death. Those you have left will come to you."

The ancient chiefs, who "first took upon themselves the authority to govern the people," are still active, and through the rituals chanted at the installation of tribal officials, as through a medium they continue to exercise their functions and to confer authority on their successors. The rituals call upon the animals which had supernaturally appeared to the first rulers, "the Crow, with frayed neck feathers; the Wolf, with tail blown to one side;" and they appeal to both chiefs and animals to remember their promise, and to continue to guide the people into safety and plenty through their successors now being ordained.

The Legend of the Sacred Pole of the Omahas, handed down from generations, gives a rapid history of the people from the time when "they opened their eyes and beheld the day," to the completed organization of the tribe, and the institution of the rites of the Sacred Pole. From it we learn that the changes in the daily life and material progress of the people did not come about through miraculous intervention, but through the mind of their wise men; and that every step in the path of progress was the result of "thought." "And the people thought," is the constant prelude to every betterment or invention. By "thought" they learned how to make fire, to build lodges, to weave, and finally to institute religious rites and ceremonies.

To quote from this Legend: "The people felt themselves weak and poor. Then the old men gathered together and said: Let us make our children cry to Wa-kan-da. . . . So all the parents took their children, covered their faces with soft clay, and sent them forth to lonely places. . . . The old men said: You shall go forth to cry to Wa-kan-da. . . . When on the hills, you shall not ask for any particular thing. . . . whatever is good, that may Wa-kan-da give. . . . Four days and nights upon the hills, the youth shall pray, crying, and when he stops, shall wipe his tears with the palms of his hands, lift his wet hands to heaven, then lay them on the earth. . . . This was the people's first appeal to Wa-kan-da. Since that time twice in the year, . . . in the spring . . . and when the grass is yellow, . . . this prayer is said."

A study of this practice, as still found among the tribes, shows that the youth, who uttered his prayer during days and nights of fasting, was not only asking help from Wa-kan-da, but was seeking a manifestation, in a vision, of that mysterious power. The form of this manifestation which should come to him, he believed to be that to which he must appeal when in need of help. The symbol of this form, which the youth ever after carried with him, did not in itself possess the ability to help, but served as a credential, by which the youth reminded the manifestation, be it of bird or beast, of the promise believed to have been received from it in the vision.

The dream and the vision were not the same, the dream of sleep came unsought in a natural way, while the manner in which the vision was striven for indicates an attempt to set aside and override natural conditions. The natural dream has exercised an influence in many ways, but it has not had the constructive force of the vision.

The cry to Wa-kan-da was the outcome of "thought" during the long barren period of primitive life. Whither this "thought" had tended we have seen in its culmination in the ideas that all things were animated by the same continuous life, and were related to each other. The generalizing ideas were not strictly in accord with the evidence of man's senses. The Indian could not help seeing the unmistakable difference between himself and all other objects. Nor could he help knowing that it was impossible for him to hold communication, as between man and man, with the animals, the Thunder, etc. The ancient thinkers and leaders met this difficulty by the rite of the vision, with its peculiar preparation. The youth was directed to strip off all decoration, to wear the scantiest of clothing, to deny his social instincts, and to go alone upon the hills, or into the depths of the forests; he was to weep as he chanted his prayer, and await the failing of his bodily strength, and the coming of the vision. In this vision he saw familiar things under such new conditions that communication with them was possible; and his belief in the reality of his vision could not but reconcile the animistic idea with the normal evidence of the senses.

The psychological conditions favorable to a belief in the visions, and the ethical influence of the rite of fasting, in its results upon the individual and upon society, cannot be considered here, but the constructive power exercised by the religious societies, which had their rise in the vision, claims a moment's attention, as pertinent to our subject.

From the legend already quoted, as well as from customs still existing in these tribes, we learn that men who had had similar visions became affiliated into groups or societies, and acknowledged a sort of kinship on the basis of like visions. For instance, those who had seen the Bear or the Elk, formed the Bear or the Elk society, and those to whom had appeared the Water Creatures, or the Thunder Beings, were gathered into similarly defined groups. Within these societies grew up an orderly arrangement or classification of the membership, the institution of initiatory rites, a prescribed ritual, and the appointment of officers.

An important stage in the secular organization of the people was reached when the acceptance of Leaders—"men who took upon themselves the authority to govern and preserve order"—came to pass. It would seem, from the evidence of traditions and rituals, that the establishment of these Leaders, which implied the segregation of the people into groups of followers, was of slow growth and attended with rivalries and warfare. During this formative period, the early leaders appear

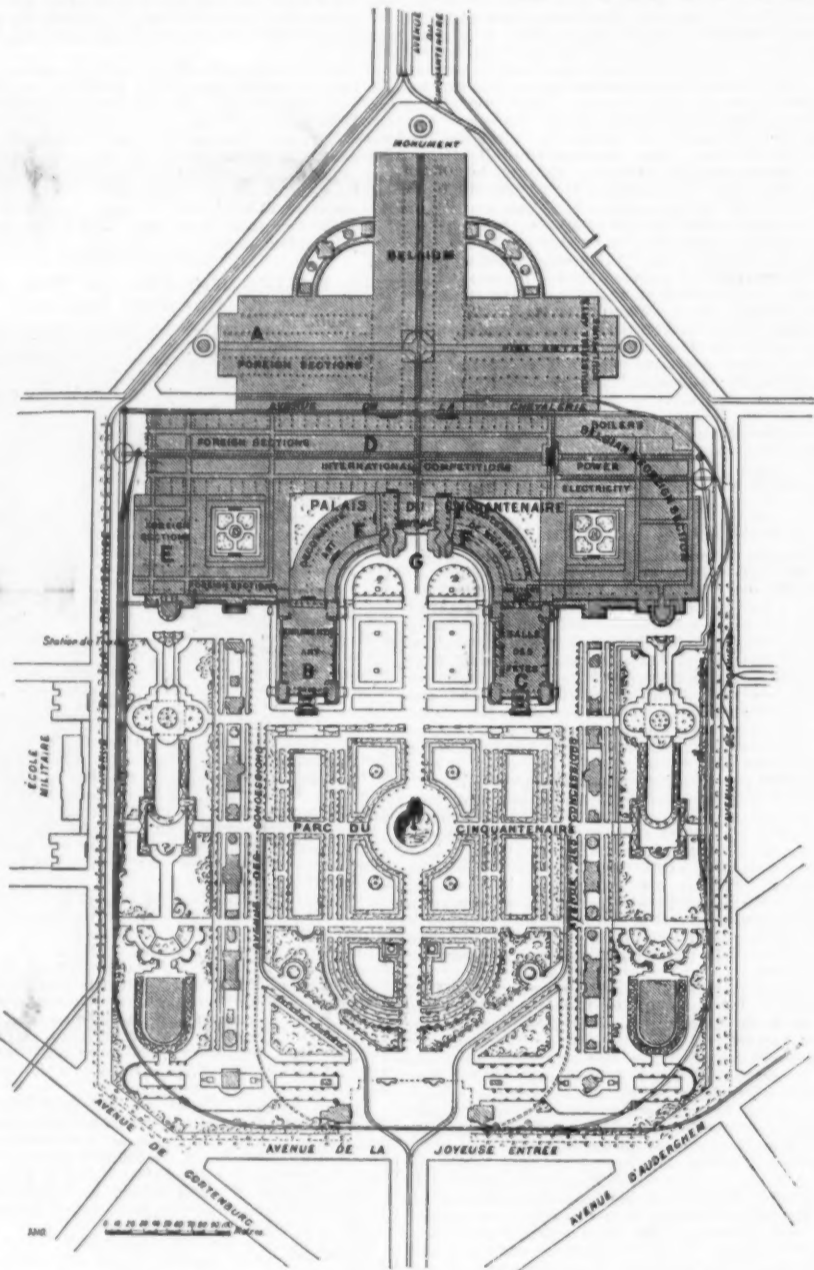
to have used the popular belief in the supernatural to strengthen their authority, so that they came to be regarded as specially endowed, and the efficacy of their vision was thought to extend over all their followers. In this way the symbol of the Leader's vision grew to be recognized as sacred to his kindred, and was finally adopted as the sign or totem of a common kinship or clan. This being accomplished, the taboo was instituted as a simple and effectual reminder of the totem of the Leader, and of the mutual obligations and relations of the members of the clan, which were further emphasized by the adoption of a set of names for each clan, all of which referred to its totem. Among the Omahas and Ponkas these names are called ni-ki-a, that is, spoken by a chief. In the ni-ki-a name, and the ceremonies attending its bestowal, there is a twofold recognition, that of a natural ancestor and that of the supernatural manifestation of this ancestor's vision. We have already seen a similar acknowledgment of a dual source of authority, where, in the rituals, the chiefs, and the animals of their visions, are both invoked.

(To be continued.)

THE BRUSSELS INTERNATIONAL EXHIBITION OF 1897.

CONSIDERING that the International Exhibition to be held in Brussels next year promises to be of a

Company, but with a government official of a government department deputed to look after and protect their numerous interests. So that while the financial future of the shareholders will be duly looked after by directors, or an executive committee approved by them, the administrative machinery of a state exhibition has been organized in order to give the necessary guarantees to foreign manufacturers who may feel disposed to participate. The reason of so marked an accession of royal aid and patronage is not far to seek. The King of the Belgians, always taking a keen and practical interest in his beautiful city of Brussels, the dimensions of which are now rapidly increasing, is very desirous of increasing its attractions by adding to it, as a place of popular resort and suburb, the Parc du Tervuren, a domain of great natural beauty and considerable extent—500 acres. But this park happens to be eight miles from Brussels and very inaccessible, hardly frequented by the inhabitants of the capital and quite unknown to visitors. To make it as popular as it should be, and easy of access, are two of the motives that have raised the importance of the coming exhibition. Not that it will be held at Tervuren, at least not the most important part, that is reserved for the Parc du Cinquantenaire, situated in the city, and the very charming though restricted site of the Brussels exhibition of 1880. At Tervuren will be the colonial exhibition, the Congo in miniature, races and temporary shows of all kinds, and other attractions that Bel-



THE BRUSSELS INTERNATIONAL EXHIBITION OF 1897—PLAN OF EXHIBITION BUILDINGS AND GROUNDS IN THE PARC DU CINQUANTENAIRE.

A. Foreign Courts. B. Art Museum. C. Salle des Fêtes. D. Machinery Hall. E. Foreign Courts. F. Porticos. G. Entrance.

NOTE.—The commencement of the new avenue (the Avenue du Cinquantenaire) leading to the Parc du Tervuren is seen at the top of this plan.

highly important character, it is rather strange that it has attracted so little attention in England, says Engineering. It is true that within the last few months an entire change has taken place in its prospects. Devised at first as a speculative company scheme, it neither commanded nor merited much attention, and, indeed, the chances are that it may never have assumed a practical form. But it has been raised recently on to a far higher level. The King of the Belgians and his government elected to take the matter in hand and to endow it with official dignity and importance. The limited liability company element has not disappeared, but, while its usefulness is preserved, it has been subordinated to the necessary degree, if foreign co-operation was to be secured. Foreign exhibitors, or the official bodies representing them, will not have to deal with the directors of the "Bruxelles Exposition"

gians know so well how to organize and enjoy. So that the Brussels exhibition will present the altogether novel plan of being held in two places, separated by a distance of eight miles. As for the means of communication, a broad avenue is now being constructed at a vast expense, connecting the two sites, and on this will be laid lines of electric railway, bringing the two places within twenty minutes of each other. Thus will the main object be served after the exhibition will have become a pleasant or a regretful memory, as the case may be; Tervuren will be known and the way to it made easy. There can be no two opinions as to the permanent benefit of this part of the scheme, which is also of great interest from the exhibition organization point of view.

As for the exhibition itself. The Parc du Cinquantenaire has about 100 acres, which will—main buildings

apart—be about equally divided between pleasant gardens and the side shows on which success depends largely. Most people know what the main buildings are like; they are sufficiently large and decorative to produce a fine architectural effect; behind the façade—with its monumental central entrance, its curved portico and two large halls—there is the great iron-roofed gallery utilized year by year for horse shows and other temporary purposes. For the rest, small galleries, existing or yet to be built, of the usual cheap and rapidly erected types, in iron, timber and glass. The plan which we publish illustrates the general arrangement clearly. As for the utilization of space, the details are not yet decided. But the great gallery will be nearly or quite filled with machinery, and the Belgian Industrial Court will occupy the building that extends at right angles from the back of the Machinery Hall. To the right of this are foreign courts, to the left picture galleries; at both ends of the Machinery Hall, more foreign courts. This is an outline of the arrangements, to be filled in later. They will be simple enough, which is a great advantage, and the space will be large enough—about a million square feet—for a minor exhibition of much importance. The contents of the exhibition are to be divided in 14 sections, 56 groups and 199 classes, covering all branches of art, industry and science. The usual routine of exhibition arrangements will be followed; Belgian courts and foreign courts; picture galleries of contemporaneous art; juries and awards, diplomas, medals, and so forth. A novel feature, however, is being seriously contemplated which can scarcely bear any but Dead Sea fruit. This is the exhibits in the International Sections, where new inventions and discoveries of value and importance are to be shown, and machines, processes and products, the practical developments of what once were new inventions and discoveries. As for these last, the commissioners of various countries will probably desire that their courts should not be deprived of such valuable exhibits. As for the former, the members of the Belgian committees created to decide on the merits of the new inventions and discoveries must be bold indeed if they will dare to face the cloud of inventors and discoverers who will no doubt descend upon the galleries in the Parc du Cinquante-naire. The sanguine and usually impractical inventor in the single specimen puts those to flight who know him and his kind, and the idea of inventors in battalions is full of terror. We trust sincerely for every reason that this idea may be abandoned.

The prospects of the Brussels exhibition as to foreign co-operation are very promising. France (possibly with an eye to reciprocity in 1900) has made a grant of £35,000; Germany has so far voted no money, but has formed a commission of the first rank, under the presidency of Prince Charles of Hohenzollern; the United States will have a court; so will Italy; the South American republics will, in nearly all cases, be represented, and it is expected that there will be Russian, Austrian and Scandinavian courts. As for this country, the government is taking a keen interest in the success of the undertaking, and at its request a British commission has been formed under the presidency of Sir Albert Rollit, and with Mr. James Dredge as executive commissioner. Of course it would be unreasonable to suppose that this commission can command success, but it may be confidently asserted that they will at least deserve it.

This much may be safely predicted of the Brussels exhibition of 1897. Though not large, it will be highly representative and thoroughly international; if our own industrials do not consider it worth while to be present, those of other and competing countries will have a different opinion. Besides being a business exhibition, it will be a pleasurable one, in all the varied methods now in vogue; therefore it will attract crowds of visitors to the bright Belgian capital.

ENGLISH COINS.

By G. F. HILL, M.A.

THE effect of the Norman conquest on the English coinage is almost imperceptible, and any change that took place was apparently for the worse. Under William I and II (whose coins have to be dealt with together, as no satisfactory distinction between the two monarchs has been arrived at) the number of types is numerous, and the facing bust of the king (Fig. 1: PILUM REX ANGLOR: reverse, MAN ON CANT-VLBI, a Canterbury penny) now begins to be very common. The silver of these coins is of about the same fineness as that of our coins of the present time. From this time the style of the coinage deteriorates rapidly, until, under Stephen, it reaches its lowest point. The coins of this period are, however, interesting for the reason that, besides Stephen and Matilda, several other persons who were conspicuous in these troubled days are represented by coins. Thus we have coins of Eustace and William, sons of Stephen; of Henry de Blois, Bishop of Winchester, and Stephen's illegitimate brother (Fig. 2: HEN [RIC] VS EPC: reverse, [STEP] HANVS REX); of Robert, Earl of Gloucester, the illegitimate son of Henry I; and of Roger, Earl of Warwick.

On his accession Henry II found the coinage in a bad state. During his reign some uniformity was brought into the system, the number of types being simplified and a single superintendent being appointed who was responsible for the whole of the coinage. In 1180 an important issue took place, which consisted of what are known as "short-cross pennies," from the double or voided cross not reaching to the edge of the coin, which is the uniform type of the reverse. These coins all bear Henry's name, although they were in part issued in the reigns of Richard I (Fig. 3: HENRICVS REX: reverse, STIVENE ON LVN, a London penny) and of John. Neither Richard nor John struck English coins with his own name. The short-cross pennies lasted until 1247 or 1248, when, to prevent the too prevalent practice of clipping the coins, the cross was lengthened. This was not the only innovation made in this reign.

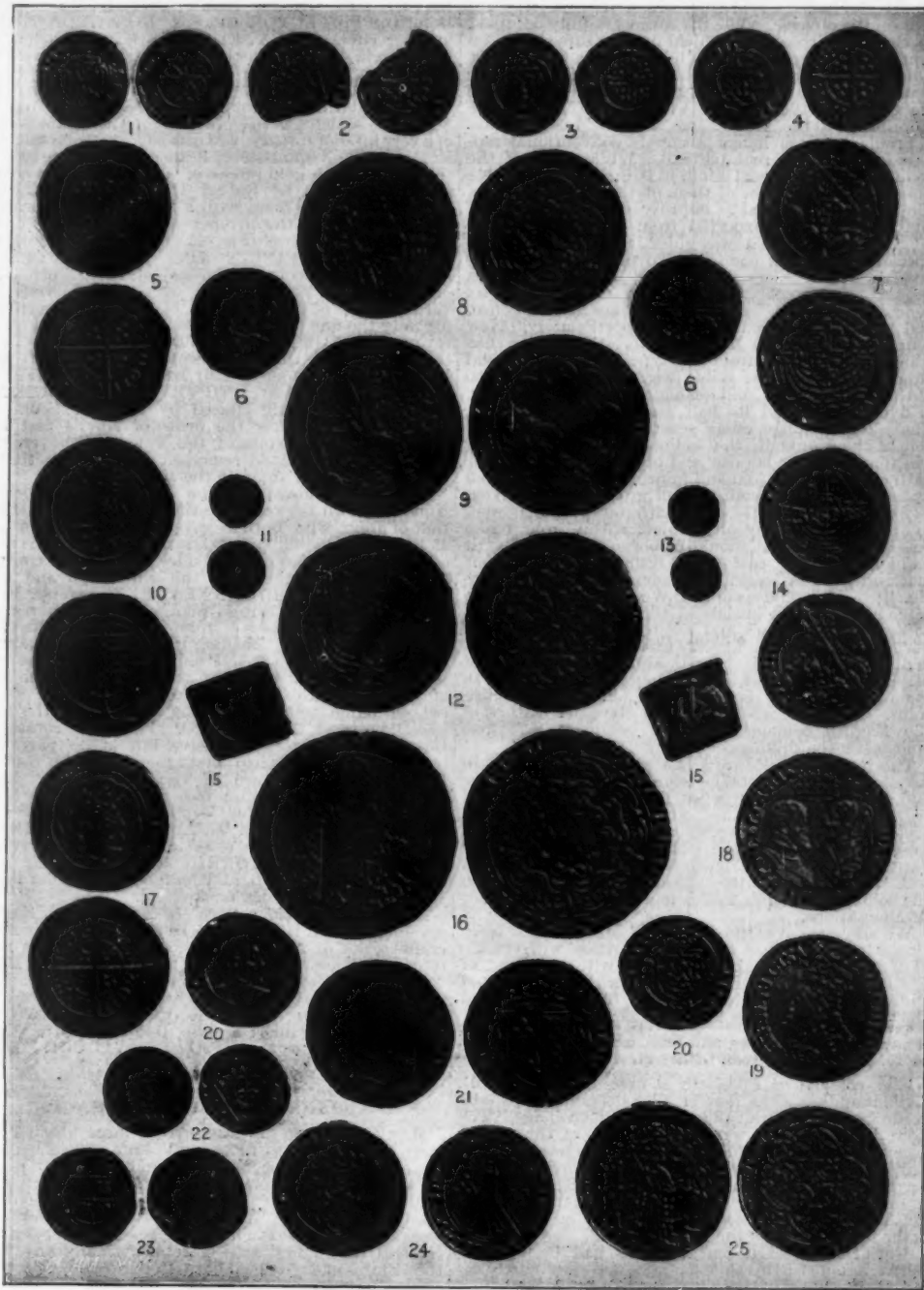
In 1257 an attempt was made to introduce a gold coinage, which had been inaugurated five years before by the coining of the first "florin" in Florence. Henry's gold pennies (each worth twenty silver pennies) were not a success. They are excessively rare. The probability is that, being of pure gold, they were speedily melted down (Fig. 6: HENRIC REX III: reverse, WILLELM ON LVNDE). Another innovation

was the placing of III, or TERCII(us), after the king's name. Curiously, this very sensible reform was not followed out by later kings, and the numerals do not appear again after the king's name until the time of Henry VII. The only lasting change made by Henry III was the introduction of three pellets in the angles of the cross; these pellets occur constantly until the time of Henry VII, and only finally disappear under James I. It has been suggested that they gave rise to the three balls adopted by money lenders as their sign.

The coins of the first three Edwards are difficult to distinguish. By this time the voided cross has given place to the cross pattee, i. e., broadening toward the ends. (Fig. 4: EDWR RANGL DNS HYB, i. e., Dominus Hybernie; reverse, CIVITAS DVREME. On this coin the mint mark, a small cross moline at the beginning of the legend, is noticeable as being the sign used by Bishop Beck, who filled the see of Durham from 1283 to 1310.) Edward I and Edward II limited their actual coinage to the silver penny and its half and quarter; but the third king of this name made a far-reaching change by the introduction of a splendid series of gold coins, as well as by striking four-penny and twopenny pieces (groats and half groats) in

word). The origin of the obverse type is uncertain, the only plausible suggestion being that it has reference to the naval victory of Sluis, won by the English four years before these coins were issued. The half noble was similar in type to the noble, but the quarter bore the shield of arms alone; the half with the motto, DOMINE NE IN FVRORE TVO ARGVAS ME, the quarter with EXALTABITUR IN GLORIA.

In 1351 the penny was fixed at eighteen grains, and groats and half groats were issued. The groat bore two circles of inscription on the reverse, the outer containing the motto, POSVI DEVM ADVITOREM MEVM, the inner the mint name (in the case of Fig. 5, CIVITAS LONDON). Before the Treaty of Breigny, in 1360, Edward calls himself King of France on his coins; from 1360 to 1369 he is Lord of Aquitaine (DNS HYB & AQT, Lord of Ireland and Aquitaine, on Fig. 5); after 1369, when the treaty was broken, he again claims the title of King of France. The half groats are very similar to the groats, and the pennies are still of the type introduced by Edward I. The coinage which was thus established by Edward III remained materially unaltered for more than a century, and his gold coinage was so fine that it was largely exported



ENGLISH, SCOTTISH, AND IRISH COINS.

silver. In 1333 Edward struck gold florins worth six shillings, with half florins and quarter florins. These, however, being valued too high in terms of silver, failed, and were withdrawn. The "noble," of six shillings and eight pence (the origin of our lawyer's fee), issued in 1344, was a greater success, though, perhaps, a less beautiful coin. Fig. 8 represents the florin, of which only two specimens are known: the king is seated, facing, a leopard on each side of the throne; fleur de lys strewn over the field. On the reverse is the motto: IHC (i. e., Jesus) TRANSIENS PER MEDIVM ILLO RVVM IBAT. The legend (Luke iv 30) was supposed to be a charm against thieves, and thus appropriate to the coinage. The half florin and quarter florin bore heraldic types (a leopard bearing a banner with the arms of France and England, and a lion standing on a "cap of maintenance," the field strewn with lys). The noble is represented by Fig. 9. Here the king is shown in a ship, with sword and shield bearing the royal arms. The reverse, like that of the florin, is purely decorative, and bears the same motto (with or without the addition of AVTEM after the first

abroad. Under the impression that the wealth of a country was measured by the amount of gold it possessed, the English legislated time after time against the exportation of gold coin, but to no effect. Not only were the coins themselves exported, but imitations of all kinds were made on the Continent, varying only in legend or in some small heraldic detail. The next change of importance in the English coinage was due to Edward IV. In 1465 this king issued a new noble worth ten shillings, and a new coin worth six shillings and eight pence to fill the place of the old noble, which had risen in value. These nobles (which were also called "royals" or "ryals") differ from the old coins in having a rose on the side of the ship, and a rose on a sun in the center of the reverse; a banner with E also flies from the poop of the vessel (Fig. 12). The half noble is similar, but the quarter bears on the obverse the shield alone, with E, a rose, a sun, and a lys around it. The rose on these coins is, of course, the white rose of Edward's family, while the sun is explained by the story that before the battle of Mortimer's Cross, in 1460, Edward's victory was portended to him by the appear-

ance in the heavens of three suns (mock suns?) The angel, or angel noble, was so called from the type of the obverse, which was the archangel Michael subduing Satan (Fig. 7). On the reverse was a ship, carrying a cross between E and a rose, and on its side a shield. The motto was a lame hexameter: PER CRUCEM TVAM SALVA NOS XPE (i. e., CHRISTE REDEMPTOR). The angelet, or half angel, is similar in type to the angel itself. As in the case of Edward III's coins, a great number of the coins of Edward IV, especially the rials, circulated and were imitated abroad; specimens exist with the countermark of foreign states, such as Dantzic, upon them.

The accession of the Tudors may be said to mark the beginning of a new era in the English coinage. The execution of the pieces is in every way worthy of the young Renaissance, and the coinage from Henry VII to Elizabeth has never been surpassed in England for decorative beauty and magnificence. Henry VII introduced the sovereign, so called from the representation of the full length figure of the king (Fig. 16). On the reverse were the royal arms in the center of the Tudor rose. This fine piece, which weighed two hundred and forty grains (our present sovereign weighs one hundred and twenty-three and a quarter grains), was worth twenty shillings of the time, or two rials. Henry also issued a ryal from which the rose was absent on the obverse, while the reverse is fully occupied by the Tudor rose with a shield bearing three llys in its center. In silver, Henry VII introduced an important coin, the shilling, weighing one hundred and forty-four grains, and equivalent to twelve pennies. On these pieces (Fig. 10) the number (VII or SEPTIM) is once more added to the king's name, and the bust appears in profile, being no longer a merely conventional representation but a real portrait. While most of the pennies are of the usual kind, it is interesting to note the recurrence on some of them of the sovereign type. The coinage continued to improve under Henry VIII, and coin was still exported from England in large quantities, since gold was rated at a higher value abroad than in this country. To prevent this it was proclaimed in November, 1536, that the sovereign should be current at twenty-two shillings and six pence, the angel noble at seven shillings and six pence, and the other denominations proportionately. New coins were also issued, the most interesting being that which was known from its type (the George and Dragon) as the George noble (Fig. 14). We have also at this time the new gold denominations of the crown, of five shillings, and its half, and the quarter angel. The silver coinage offers several points of interest. One of the counts in the indictment against Wolsey was that "of his pompous and presumptuous mind he hath enterprised to join and imprint the cardinal's hat under your arms in your coin of groats, made at your city of York, which like deed hath not yet been seen to have been done by any subject within your realm before this time." It should be borne in mind that it had long been the custom for bishops to place their mark on pennies issued by their authority (compare No. 4); but it would seem that Wolsey had ventured to place his mark and initials on the larger coins issued, at York, by the king's and not by his own authority. Several groats and half groats exist with T W to right and left of the shield of arms, and the cardinal's hat beneath it. From the time of Henry VIII the shield in some form or other is present on almost all English coins. The cross, which had been the chief feature of the English coinage since the conquest, was first omitted on the shillings of Henry VIII.

The interest of Edward VI's coinage lies chiefly in his silver. In this metal he issued crowns, half crowns and sixpences. The sixpence, like the shilling, bore a crowned bust, sometimes in profile to the right, sometimes facing; the crown and half crown bore the king on horseback to the right. Two great practical improvements in the English coinage are to be imputed to Edward VI—the introduction of dates and values on the coinage, although this is limited at first to a few denominations.

We may pass over the coinage of Mary with a mention of the fact that, after her marriage with Philip II of Spain, she struck half crowns with the head of Philip on the reverse, and shillings with her own and Philip's heads confronted (Fig. 18). This type inspired the well-known couplet in Hudibras:

"Still amorous, and fond, and billing,
Like Philip and Mary on a shilling."

The coinage of Elizabeth is exceedingly plentiful. Besides adding some new smaller denominations, she made various material alterations in the coinage. The new denominations were the threepence, three halfpence and three farthings. We illustrate here only the halfpenny (Fig. 11, with the Tudor portcullis) and farthing (Fig. 13, with ELIZABETHA R in a monogram, crowned). The most important innovation of Elizabeth's in the process of coinage to be chronicled is the introduction of the use of the mill.

Until the sixteenth century coins had been struck with a hammer; this slow method was now partly superseded, at first in Germany, then in other countries, by a machine put in motion by hydraulic wheels, and hence known as a mill. The use of the word "milling" to describe the roughened edge of modern coins is inaccurate, and the milled coins of Elizabeth and her successors can only be distinguished from the hammered by the greater neatness of the workmanship (Fig. 19 is a milled half sovereign of Elizabeth). For some reason the new process was only employed for a limited number of coins, and the hammer was not finally superseded by the mill until the time of Charles II (1682).

To the time of Henry VIII the English coinage had maintained a very high level of purity, which accounts for the constant exportation of English money to countries where the coinage had become debased. For the sake of a little immediate profit, and perhaps to prevent this constant exportation, Henry issued gold and silver coins of a base quality, and his example was followed by Edward VI and Mary. Elizabeth, however, was wise enough to see the badness of the system, and called in all the base coin. She seems, however, to have thought it good enough for Ireland, for it was passed over to that country.

The issue of so many small denominations in Elizabeth's reign is evidence of the general desire for small change. There exist patterns made under Elizabeth

for copper coins, but it was not until the time of James I that an official copper coinage was issued. Meanwhile the want was partly supplied by the issue of private tokens. These were given in change, and when, say, twenty-four farthing tokens of the same kind had been collected, the person who issued them would redeem them by payment of sixpence in coin of the realm. A private token coinage seems to have existed as early as the fifteenth century, but the nature of the tokens then used is involved in some obscurity. It is not, in fact, often certain whether the known leaden pieces of the fifteenth and sixteenth centuries were tokens or merely counters used for reckoning. Between 1590 and 1600 Elizabeth granted permission to the city of Bristol to issue city tokens, all private tokens being called in. A specimen issued early in the seventeenth century is illustrated here (Fig. 15: obverse, C B, for Civitas Bristol; reverse, the city arms).

The coinage of Scotland, which commenced in the reign of David I (about 1124), was at first an imitation of the English coinage. It can hardly be said to have been important before the time of David II (1329-1371), who imitated the gold nobles of Edward III, and also issued groats and half groats, in addition to the smaller denominations which had been introduced by his predecessors. The groat here illustrated (Fig. 17: obverse, DAVID DEI GRATIA REX SCOTORVM; reverse, Domini NUS PROTECTOR MEUS & LIBERATOR MEUS; in inner circle, VILLA EDINBURGH) was struck at Edinburgh. The stars which here take the place of the balls in the English coins are characteristic of Scottish silver coinage from William the Lion to Robert II. Like the Continental coinage of these times, that of Scotland—which was in close relation with France—was of a very inferior quality, and caused many complaints in England. The influence of France may also be seen in the first Scottish gold pieces of an original character, viz., those issued by Robert III. These are the St. Andrew crowns or lions, with a crowned shield bearing a lion rampant on the obverse, and a figure of St. Andrew on the reverse (Fig. 24: XPC, i. e., Christus, REGNAT XPC VINCIT XPC IMPERAT). In style and legend these coins remind us of the French coins of the period. We must pass over the numerous and various issues of the successors of Robert III, mentioning only the fine "bonnet piece" of James V (Fig. 20: reverse, HONOR REGIS IVDICIVM DILIGIT), to the time of Mary Queen of Scots, whose portrait may be seen on the testoon of 1561 here illustrated (Fig. 21: reverse, SLVVM FAC POPVLVM TVVM DOMINE, arms of France half effaced by those of Scotland), which was struck after the death of Mary's first husband, Francis. In spite of the union of the crowns, the coinage of Scotland remained distinct from that of England until the union in the reign of Anne.

The Irish coinage may be dismissed very briefly. None is known between the time of Æthelred II and that of John, who, both as governor of the island and as King of England, struck a series of coins. His regal coins have triangles on both sides; on the one containing the bust, on the other the sun, moon and stars (Fig. 22: obverse, IOHANNES REX; reverse, ROBERT ON DIVE, a Dublin penny). More interesting, however, than the coins of John himself are the silver "Patriek farthings," reading PATRICI on one side, and DE DVNO OR CRAGIE on the other. These were struck at Downpatrick and Carrickfergus by the Earl of Ulster and Governor of Ireland, John de Curcy (whose name occurs on some in place of the mint name), between 1181 and 1189. The Irish coinage of Edward IV was very extensive, but of no particular interest. The Irish harp first appears on the coins of Henry VIII, which are of very poor metal. Elizabeth's Irish silver was also base; but this ruler introduced a coinage of actual copper pence (Fig. 23: obverse, ELIZABETH D. G. AN. FR. ET HIBER. RE, with E R at the sides of the shield; reverse, POSVI DEV. ADIVTOREM MEV., with the harp crowned and date 1601), and halfpence of similar types. No gold was ever struck for Ireland.

As rulers of various parts of France, the English sovereigns, from Henry II to Henry VI struck considerable series of Anglo-Gallic coins. Among the most interesting are those issued by Edward the Black Prince, one of whose pavilions (struck at Bordeaux) is all that we have space to illustrate here (Fig. 25: obverse, EDWARDUS PRIMOGENITUS REGIS ANGLIE PRINCEPS AQUITANIE; reverse, Domini NUS ADIVTOR & PROTECTOR MEUS & IN IPSO SPERAVIT COR MEVM. Burdigala).—Knowledge.

AN INDUSTRIAL DEMOCRACY.

MANY have been the attempts of large hearted and large minded men to remove the antagonism between the employer and the employed, and to bring to practical realization some plan of co-operation, or profit sharing, or other device, that shall unite all the factors of production in one harmonious whole, where each worker contributes the highest efficiency of service and receives the highest rate of return. Many have been the failures of such attempts. In our own country the successful instances have been few indeed. In England the record is somewhat better, but even there the successful cases of co-operation have been far outnumbered by the failures.

Of special significance, consequently, is the history of an experiment in our own country that has to a remarkable degree succeeded in eradicating the hostility between labor and capital, and in demonstrating that a gain to the employer can be most effectively achieved through a gain to the employed.

It is the establishment of the National Cash Register Company at Dayton, Ohio, that has been the field of this experiment.

This concern, which sends its product throughout the entire civilized world, reduced the organization of its selling and recording departments early in its career to a most systematic and efficient basis. The organization of these departments was so thorough, indeed, that for some years their efficiency sustained a comparative lack of system in the making or factory department. This latter department was organized in the conventional fashion, with a superintendent at the head intrusted with all authority and responsibility, and a body of workmen regarded strictly as the wheels of a machine whose highest efficiency depended upon reducing them as nearly as possible to the action of machines.

When the task of bringing the factory to the same

efficiency as the selling and recording departments was undertaken, one of the first steps was to replace the superintendent by a committee of five heads of departments, upon whom the responsibility of the factory management was placed. This principle was afterward extended to subcommittees of foremen and subforemen, upon each of whom the largest possible amount of responsibility and initiative was placed, and who to a large extent settled all matters within their own immediate province. These different committees are very similar in their functions to Congress and the State legislatures, the head committee making rules and effecting decisions which serve for the guidance of the entire establishment, and the minor committees having jurisdiction within their special domains.

To extend still further the principle of individual initiative, an autographic register is placed in every department of the factory, on which the employees are invited to write suggestions or criticisms that may be of service in the conduct of the business. For the best suggestions, prizes are awarded. Last year these amounted to \$600. To each one of the prize winners a diploma of award is given, and his name is added to a permanent roll of honor which hangs in a conspicuous place in the main factory building. The presentation of these prizes is always an occasion of some importance. All the employees are gathered together, and speeches are made by the officers of the company. From this system of awards have been gained substantial advantages. Many of the suggestions so secured have proved of direct financial benefit to the company, in the way of either lessening the cost of manufacture or improving the construction of the machines. The plan has encouraged the men to read, observe and think, and has been a beneficial influence in educating and broadening them.

The payment of high wages is also an integral part of this system of individual incentive; for the company have found that nearly all workmen increase their daily output when sure of an increased return. In this way, the entire establishment has been converted from a mass of more or less irresponsible workers into a hive of workers and thinkers, each one of whom is inspired with the effort to benefit his own position by benefiting the company.

By thus offering premiums for hard work and intelligent co-operation, a high quantity of production and a high quality of work, with a steadily diminishing cost, has been maintained, and a general air of intelligence has taken the place of the treadmill methods of the old factory.

The endeavor is made to make the system as nearly automatic and independent of any one man as possible. The necessity is impressed upon each of performing the most important things first, and of delegating to those under him all the work possible. All the men are supposed to be specialists in their own departments, and the different foremen are encouraged to solve their own problems. This enables the officers to throw off the details of the business, and to keep their attention on the weakest point as long as it may be necessary.

The company has found that to accomplish the largest amount of work possible, the men must be healthy. They therefore endeavor to teach them how to take care of their health, in frequent talks, and through the columns of their paper. The whole office force is given systematic calisthenic exercises in the middle of each morning and afternoon. When the new building is completed, there will be baths, where each employee may bathe once a week in the company's time.

Much has been said upon the bad effect of factory work upon the health of women and girls; but in this institution, at least, no such charge can be made. The women go to work half an hour later than the men in the morning and leave fifteen minutes earlier at night. They are also given fifteen minutes recess at ten in the morning and at three in the afternoon. Five minutes of each recess is given up to gymnastic exercises, under the guidance of a capable leader. Every woman employee is also given a half holiday on Saturday, and in addition a whole holiday each month. They work in clean, airy rooms, separated from the men, under forewomen of high character. Rest rooms, furnished with cots, are provided in each department, and clean aprons and sleeves are supplied by the company. Each department has a colored janitress, and at the noon hour, hot coffee, tea, and soup or some other nutritious food are furnished to women employees. The average cost of these lunches is about three cents each, and it has been found that by reason of them each woman does one-twentieth more work each day. This amounts to five cents apiece, making the gain two cents, or 66 2/3 per cent. When this feature was instituted, an instant improvement in the general health of the women was noticed. There were less delays from sickness, fewer absences, and an ability to work harder and more enthusiastically than when they ate cold food.

Each young woman is also given a ticket admitting her to the weekly cooking classes of the Women's Christian Association and to the other privileges of the Y. W. C. A. club house. One of the rules of the company is to employ no young women who are not graduates of the high school. They have found that when the hours of labor are shortened and safeguards to health adopted, persons of education and superior mental power are immediately attracted to the work, and it is easier to retain them after they have become skilled. From the purely financial standpoint, they find that the same number of young women turn out more work of a better quality, at a less cost to the company, than was ever done under former conditions.

In addition to their regular duties in the various departments, one of these young women constitute a committee on decoration, which has charge of all flags, floral decorations, landscape gardening and other similar matters about the factory.

Another unique feature is the training which the members of the selling force obtain before they start out to sell the registers. Each of them is brought to Dayton, and spends a month there at the company's expense. During this time they attend daily sessions of a regular school, which is in charge of the most experienced and able salesmen in the company's employ. Text books are furnished and each scholar is required to pass a regular examination. The resources of elocution and philosophy are drawn upon to make this training as perfect as possible, and of sympathy and ap-

preciation in the salesmen, are strongly emphasized. The attempt in this school is to make salesmanship an exact science, and it is believed to be the only place in this country where the subject is taught on a thoroughly organized and systematic basis.

One of the most significant features that has been instituted is the Advance Club; this club, of two hundred members, being composed of the heads of departments and divisions, and the members of the office force, who meet weekly in the company's time to consider the thirty most important problems of the business. At the club meeting, co-operation is asked for as one man asks another, and a hearty response is never wanting. Those who visit the factory declare that the enthusiasm shown by all connected with it is one of the most striking things which comes to their notice.

Every day at noon the officers of the company and some fifteen heads of departments dine at the club house on the lawn. These daily meetings of officers and heads of departments are in fact daily committee meetings, where matters of much interest to the company are often talked over and settled.

The company also furnishes a club house for the use of its men employees. Here the literary and social side is cultivated. The club house, which is also the library, is supplied with magazines and other periodicals, and the daily papers. The house is open in the evening, and once a week a regular meeting is held, at which important papers are read by prominent preachers, lawyers and business men of the city.

Another interesting product of this interesting establishment is a sixteen page semi-monthly called the N. C. R. This publication serves as a medium of communication with all the workers. In each number are set forth a number of definite problems of the business, needing solution. The discussions and decisions of the clubs are recorded, reports from all over the field of work are printed, and the life of the entire establishment epitomized.

Once a year a convention is held at which are gathered together the twelve hundred factory employees and two hundred and fifty sales agents from all parts of the world. At these meetings, which continue for a week, a general interchange of ideas is effected, and an immense amount of enthusiasm is developed. The company counts these conventions as one of their most valuable institutions, and feel that the return from them has paid their expense many times over.

In all these innovations, the officers of the company make no claim to philanthropic motives, but simply to have acted as business men influenced by enlightened conceptions of their own interests. They have been rewarded by the faithful, friendly services of their people, who have become a home loving, home owning community, and have found that whatever benefits the company benefits them, while loss to the company in any way means a corresponding loss to them.

I cannot do better in ending the sketch of this establishment, than by quoting the closing words of an address of its president before the Present Day Club of Dayton, on January 28:

"Our system is the new factory system, and is as great an improvement over the old as the new high school is over the old high school. Under the old system too much merit in an employee was side tracked before it came to the notice of the officers; the workmen were nearly all eye servants who did their best only when a foreman was watching, and those who were dull and slow did not get much aid. In the new factory, dull ones are awakened to effort by the example of others who were formerly almost as dull as themselves. Our new factory life is an educator which trains workmen to regard the factory as a fine piece of mechanism in which each individual is an important part. The intelligent co-operation required of each person is a powerful aid to good citizenship.

"We were long ago impressed with the idea that many changes should be made in our system, but were timid in taking any new steps. Many prejudices had to be overcome before the strong desire to deal justly with our employees took effect. When we saw that it was not only just, but to our own interest, to adopt a system of mutuality, we gradually made the change. We learned that in order to gain unusual ends one must adopt unusual methods.

"We now aim for co-operation and the strength there is in union; and the more we strive for this, the more success we meet. It seems to us after trying both the old and the new factory system, that in the latter lies the closest realization of the words of Abram S. Hewitt, who said:

"Beyond all dreams of the golden age will be the splendor, majesty and happiness of the free peoples when, fulfilling the promises of the ages and the hopes of humanity, they shall learn to make equitable distribution among themselves of the fruit of their common labor."—C. R. Richards, in Pratt Institute Monthly.

THE ART OF BRONZE CASTING IN EUROPE.*

By GEORGE SIMONDS.

ABOUT ten years ago, it was my privilege to deliver an address in this room on "Artistic Bronze Casting," and when I received the invitation of your society to read another paper on the same subject I confess that my first impulse was to avoid the task. I was afraid that I should, of necessity, go over much of the same ground that I had traversed on the former occasion, and only weary you by repetition. Besides this, I had fresh in my memory that admirable paper on "Japanese Bronze Casting," delivered some twelve months ago, when Mr. Gowland treated the whole practice and theory of bronze casting in so complete a manner that it seemed superfluous for anyone to say more on the subject, unless he could show some entirely new process, or point out some hitherto unknown principle of the art.

Now, I confess, I have no such discovery to boast of, and yet I am here. I remembered that the historic side of the question had not been touched on in my former paper, which was almost, if not entirely, confined to the technical difficulties which this art presents. I propose, therefore, to treat the technical part as concisely as may be consistent with lucidity, and I do

this with an easy conscience, as many of you are familiar with the process, and there are now several bronze foundries in England where excellent work is carried out on the waste wax system.

When Mr. Alfred Gilbert, Mr. Onslow Ford and myself first began to agitate for the introduction of waste wax bronze casting in this country, there was scarcely anyone in England besides ourselves who had any knowledge of the subject; nor was there any foundry on this side of the Alps where waste wax casting was practiced or understood. For years we were unable to awaken any interest in the subject, but at last I was asked by the editor of the English Illustrated Magazine to write an article on bronze casting, which was published in 1883. This was followed, curiously enough—for there was no prearrangement—on the very next day by a most interesting lecture at the Royal Academy by the late Sir Edgar Boehm, assisted by Mr. Alfred Gilbert.

In 1884 further interest in the subject was aroused by the very able and interesting report of Sir J. Saville Lumley to Earl Granville on bronze casting in Belgium, where the waste wax process had just been experimentally introduced by the Société Anonyme des Bronzes, at Brussels. In Paris also, M. Gannon had produced more than one work by the wax process, although it was stated, I do not know with how much truth, that these were only partial successes, having need of very considerable repairs and chasing before leaving the foundry.

From that time to this the interest in this process has gone on increasing; and there is now no difficulty in getting bronzes cast by the wax process in England. This, and the advance in sculpture that has taken place in the public estimation during the last twenty years, must be my excuse for again addressing you on the same subject.

As to the antiquity of bronze casting in Europe, we only know that it dates from prehistoric times, and that it is impossible to say how or where it originated, or to give to any individual the credit of its invention. Sir J. Saville Lumley says that, according to several Danish and German writers, the European bronze of prehistoric ages was probably an indigenous industry, not of Phœnician origin, but originally discovered in Britain. I am content to accept this theory as being quite as worthy of belief as the legend for which Pliny is responsible, that the art of bronze casting was invented by Seytes, the Lydian, or Theophrastus, the Phrygian.

The Palafites, or lake dwellings of Savoy and Switzerland, have yielded a very considerable harvest of early European bronzes, and also, in some instances, they have preserved some record of the manner in which these were produced. At Thonon, in Switzerland, a mould for a spear head was found which was composed of two slabs of stone, on each of which a spear head was cut out to a proper depth. The two stones, being placed face to face and bound together, would form a very simple but effective close mould from which many casts could be taken, without any injury to the mould itself. It is this mould of which Sir J. S. Lumley says that a modern lance head was produced from a prehistoric mould. It is probably the earliest known example of piece moulding among European bronze founders.

All their works, however, were not produced by piece moulding, since another mould was found, made of clay over a wooden pattern which seems to have been burned out, leaving the cavity to receive the molten bronze. In this, then, we find the first principle of the wax process, namely, the destruction or "wasting" of the pattern by fire.

This earliest process, which we may term a waste-wood process, would be only applicable to simple forms on account of the difficulty of completely destroying the wooden pattern, and afterward getting rid of the ashes from the cavity of the mould; but it was a great discovery, and doubtless the genius who invented it would not be long in discovering that other substances more easily wasted by fire, such as wax, were capable of being fashioned into various shapes, and of being advantageously used as patterns for bronze casting; and there is every reason to suppose that the more important works found among the lake dwellings of Lake Bourget were cast by the very waste wax process which we have been trying to revive in England, for the highest class of bronze statuary.

In the opinion of Count Casta de Beauregard, whose discoveries in Lake Bourget have so greatly enriched the museums of Aix and Chambéry, these settlements were destroyed by a race of men of the Iron age, who carried fire and sword through the district long before the Roman era. Be this as it may, there can be no doubt as to the great antiquity and artistic value of the wax process, and, moreover, as the ancient European nations do not seem to have been in the habit of making piece moulds, except of the most simple description, namely, in two halves, it is not easy to see how else they could have executed large or complicated works. It is true that clay figures of the Tanagra type were got from moulds which were made, as I believe, in two halves, and some of these figures seem to be of a complicated character. Yet the heads and arms seem to have been moulded separately, and the undercutting in folds of drapery, etc., to have been omitted. Each of these figures therefore would consist of the following separate simple piece moulds: First, the body or trunk of the figure; second, the head; third and fourth, the arms; four moulds in all. After the soft clay had been squeezed into these moulds it was an easy matter to join heads and arms to the trunk of the figure and to retouch the whole, which was then allowed to dry, after which it was fired in a kiln and became terra-cotta. This principle of dividing the figure into several parts to be afterward joined up to form a complete whole was a great discovery in the art of the moulder.

Of all the European nations of remote antiquity the Etruscans and Greeks stand forth pre-eminent as artists and when we think of antique sculpture, whether in marble or bronze, it is Greek sculpture that is always in the foreground of our thoughts. And it would be strange if this were not the case, since we possess in our museums so large an amount of works, which although they are chiefly rather from Rome than of Greece, yet the Roman sculpture being greatly an echo of the earlier Greek art was inspired by Greek legends and traditions, and executed almost without exception by the hands of Greek artists often brought as slaves from Greece to Rome, and employed by their conquer-

ors to reproduce the originals they had brought to Rome as the spoils of war.

In ancient Greece, the art of the statuary in bronze was held in high estimation; the desire of possessing bronze statues of divinities, heroes and statesmen seems to have been insatiable, and there were more bronze statues than we modern sculptors can conceive of.

It is then of Greek bronze casting that I propose to speak first. According to some old author—Pausanias, I believe—the art of modeling the figure, and of casting it in bronze, was first practiced at Samos about 700 B. C. Many writers on art have put forward various theories as to how the old bronze statues were produced, and as many of these writers knew nothing about bronze casting, their ideas were often somewhat absurd.

Winckelmann, for instance, states that the horses of St. Mark's, at Venice—of which there are four—were all cast out of two moulds, not knowing that the mould is destroyed every time a bronze casting is made. Lemot, the French sculptor, who made some repairs to these horses, when they were taken to Paris by order of Napoleon the First, had ample opportunity of examining them, and found that their heads and necks were cast separately, and that collars had been added afterward to conceal the joints. This is not surprising. It is very doubtful if the Greeks or Romans ever attempted to make castings of the dimensions that we find to have been successfully carried out in later ages. It is pretty certain, I think, that they cut up their larger works, and cast them in parts, which were afterward fitted together on much the same system as the terra-cotta figures were produced in clay. There is much to be said in favor of this system for large work, and little to be said against it. I will try briefly to tell you what, in my opinion, are the advantages and disadvantages.

A bronze casting, unless it be of very small size indeed, is always cast hollow, and in order that it may be so cast, it is requisite that it should have a core inside as well as a mould outside it.

Now it is clear that if an object like a horse is to be cast, with a core inside, and if it is to be cast all in one piece, then that core will have to stay inside, since there will be no opening whereby it can be removed. Now the great weight of the core inside is a considerable disadvantage in erecting or moving a statue, and puts an unnecessary strain on the legs, which have quite enough to support without it. Moreover, the material of which cores are composed is excessively porous, taking up moisture greedily from the air, so that it is a source of danger to the thin bronze statue, which is certain not to be absolutely air and damp proof. There will be here and there some tiny fault, through which the core will absorb, and at last become so moist, that a severe frost might swell it almost to bursting. If the horse is cast without his head and neck, the core is easily removed and these dangers avoided.

There is, however, a more weighty reason for casting a horse without his neck and head. When the bronze is poured into a hollow mould it is at a temperature of, roughly speaking, 1,900°; consequently the air in the mould is expanded so suddenly that, unless escape were provided for it, an explosion would be the result; but although the main body of air escapes through the vents, there seems to be a film of air remaining, which, I imagine, prevents actual contact between the walls of the mould and the metal, so long as the latter is in motion and the mould is not yet full. When the mould is full, the outward pressure of the fluid metal forces this film of air out through the pores of the core and of the mould; those of the mould give a fairly free passage outward, but the core cannot do so, however porous it may be, if it is enveloped on all sides by the bronze. In this case the gases that should have passed away through the core come boiling up through the fluid metal, forcing their way to the vents, which, themselves full of metal, can no longer act. The gases become imprisoned in the bronze as it sets, and the result is a bad, unsound casting, "blown on the core," as we say, and full of holes like a sponge. To avoid this the ancients cut their large works to pieces. The only drawback to cutting is, that unless it is skillfully done, it is impossible to join it again without altering the movement or proportion to some extent.

There are various ways of making these joints in bronze, but at present I will merely say that the ancients used to cover the joints if possible with a bracelet or a band of ornament of some kind, and joined the parts together with rivets. They also made a species of box joint by bending a strip of metal round the inside of an arm, and riveting it in such a manner as to allow a couple of inches to project beyond the edge of the cast metal; this projection was then forced into the corresponding edge of the part to be joined, and secured in position by rivets. These joints were frequently further strengthened by dowel plates of a double dovetail form, which were countersunk in the thickness of the bronze, so that one dovetail was on each side of the joint. In principle this method is much the same as that now in use, though in practice we have somewhat improved upon it. The system of cutting was, I think, always practiced by the ancients, except in the case of very small bronzes, such as the little Victory or Fortune, whichever she may be, and the charming statuette of Venus, both of which are in the Naples Museum, as are also those other highly interesting examples of bronze work, which I have now the pleasure of bringing to your recollection.

The ancients, as far as I can discover, did not understand the practice, now almost universal, of putting a "lantern" into the core, and of core vents. I shall speak of these later on, merely observing at present that it is possible to get very small castings quite sound even when the core is shut in, and gives no exit whatever to the gases. This is, however, a difficult matter, because it is essential that the metal should be poured at its lowest possible temperature—that is to say, it must still be quite fluid, and fill the mould easily and at once. It must also be a very thin casting, and solidify before the heat has penetrated the core to any distance, in which case little or no disturbance can take place.

It is a matter of great difficulty to pour these small castings at the proper temperature, and in many cases it will be found that they have blown on the core from being too hot and setting too slowly, or that the metal has not been fluid enough to fill the mould properly and insure a sharp casting.

The works of vast dimensions which were so often executed by the ancients, of which the most generally

* Lecture before the Society of Arts, from the Journal of the Society.

known is the Colossus of Rhodes, were probably not cast in very large pieces, but in sections of very considerable thickness, with flanges on the inside by which they could be bolted or riveted together. They could thus be built up from the ground without the elaborate internal framing which would have been needed had they been, as some writers have supposed, made of thin wrought plates and riveted together. Indeed, the difficulty of executing large works in beaten plate is so much greater than that of casting that it would only be used under very special circumstances. It was so used by Ernest Rietschel, of Dresden, for the statue of Brunonia in a quadriga with four horses all larger than life. The reason for its use in this case being that the gateway at Brunswick, on which it was to be placed, was not considered strong enough to support the weight of cast metal. That the colossal statue of Apollo at Rhodes was cast work, and not beaten, I think is fairly certain, since it would seem that it lay prone and in ruins for nearly 900 years, after which the metal was sold to a Jew, who it is said loaded 900 camels with his purchase. The weight of metal is said to have been 720,000 lb., and it seems hardly likely that sheet metal would have lasted so long, or that it should not have been stolen away long before, had it not been for the size and weight of the pieces of which it was built up. This is almost all that I can tell you of the methods of the Grecian bronze founders, and of the sort of work that they produced.

Of the Romans I can only say that, although they had a passion for sculpture, they do not seem to have cared to produce for themselves that which they could more easily acquire by conquest. We find accordingly that whenever they wanted sculpture for any purpose they stole it from other people, and where this was not possible, owing to the non-existence of anything suitable to their purpose, they employed foreign artists in the execution of the work. The fashion of collecting bronzes in this simple way was set, so we are told, by no less a personage than Romulus himself, who carried off from Carnerium a bronze quadriga, which he placed in the temple of Vulcan, after having had a statue of himself placed in the car. We do not know who made the statue of Romulus, but it could hardly have been by any save an Etruscan artist.

According to Plutarch, one of the Tarquins dedicated a quadriga to Jupiter Capitolinus, and we are told that artists were brought from Veii for its execution. This seems probable, since Veii is only some 12 or 15 miles from Rome, and was an ancient and civilized city long before the days of Romulus and Remus.

As early as the days of Numa laws were made concerning sculpture, and one of these forbade the representation of the gods. But it does not seem to have been observed, since Tarquinius Priscus employed the sculptor Vulcanius, of Veii, to make a sculpture of Jupiter, which he placed in his temple on the Capitol. Another curious law of Numa's restricted the height of statues to great men. These were not to be more than three feet in height, and were hence known as tripedane. It is, therefore, to be presumed that "half life size," as we should now call it, was the size of the statue of Horatius Coclès, which was erected in the comitium after his noble defense of the bridge.

For very many years, then, the Roman demand for sculpture, whether in bronze or in marble, was supplied by foreign lands and foreign hands. Indeed, we are told by Perkins that the first foreign sculptor of whom any record is found was one Manurius Vitturius, who seems to have made copies in bronze of the ancile, or little shield which the Romans believed to have fallen from heaven; and although after that period a few names are found, still they are merely exceptions that prove the rule.

Greek artists, however, had been brought to Rome, and with them the traditions and practice of their native art. That these rapidly deteriorated among their new surroundings is hardly to be wondered at, since their employers and their public lacked the appreciation and the cultivation of ancient Greece. The emperors changed the fashion in art according to their own whim or love of ostentation. Caligula, says Perkins, decapitated Greek statues, and placed upon them his own vile head, while Nero gilded the masterpieces of Lysippus, and employed Zenodorus to erect a colossal statue of himself, which is estimated to have cost a sum equal to about £3,600,000 of our money. Pliny remarked that it showed how much the art of casting in bronze had deteriorated. It is hard to understand how this vast sum could have been spent on this statue, and it is a pity that we do not know more about it. It lasted, however, but a short time, having been destroyed by the people of Rome to mark their hatred of the man it represented. We have another work, however, of that period, in the equestrian bronze statue of Nero, in the museum at Naples, of which I am able to show you a photograph on the screen. I am, however, of the opinion that this statue is rather a Greek than a Roman work, although I can give no account of its history or authorship, save that it was found at Pompeii.

(To be continued.)

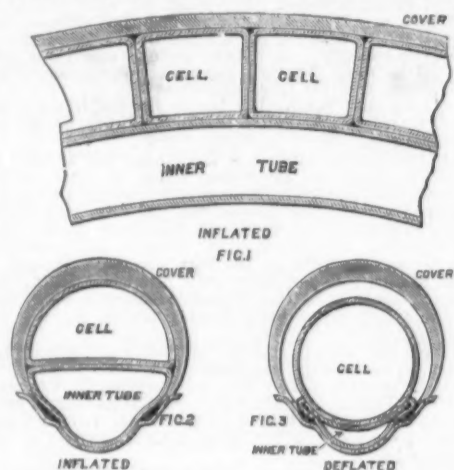
URANIUM AND ITS PROPERTIES.

H. BECQUEREL showed some months ago that the salts of uranium emit radiations possessing properties some of which are comparable to those of Roentgen's X rays. In a recent paper he gives further details, and states that he has also experimented with metallic uranium, in the state of powder, and finds that it possesses the same power in a more marked degree, this being the first case recorded of a metal possessing what may be termed invisible phosphorescence. According to H. Moissan uranium can easily be obtained in the metallic state by decomposing the double fluoride of uranium and sodium, either by means of metallic sodium or by electrolysis; or better, it may be readily produced by reducing uranium oxide by means of carbon, in the electric furnace. All three methods furnish good results, and as much as 15 kilogrammes of the metal has thus been prepared for recent investigations. It is stated that uranium can be obtained in crystals, and that the pure metal has properties closely resembling those of iron, especially as regards filing, carburizing, tempering, and oxidizing. It combines with oxygen, however, with even greater facility than iron, and in fine powder slowly decomposes water in the cold. The action of uranium upon the hydrides is also more en-

ergetic than is that of iron, and the metal possesses a great affinity for nitrogen, but does not affect the magnetic needle. Moreover, it is much more volatile than iron in the electric furnace.—Comp. Rend., cxlii, 1086 and 1088.

AKROYD'S CELLS FOR PNEUMATIC TIRES.

The accompanying engravings illustrate a form of tire known as the Akroyd cellular tire, constructed so



as to allow of a number of punctures without totally collapsing it. As will readily be seen by the illustrations, the air cells are simply small segments of flexible tube with closed ends. These are placed externally on the inner tube—Fig. 3—which is then inflated in the usual manner. As it expands it compresses the air cells—Figs. 1 and 2—to the shape of the outer cover or jacket. With the present forms of pneumatic tires and inner tubes, when a puncture occurs the rider has to patch the tire, which under any circumstances on the road is not a pleasant job. It is claimed that with the Akroyd cellular tire this is avoided, for, if punctured, it only affects one of the many air cells.

The air cells are manufactured so as to be applied to all present tires having an inner tube and outer cover. It is said that the addition of these air cells to many existing pneumatic tires has been proved not to interfere with their elasticity.

We have not tried these cells, but as they are presumably filled with air at only atmospheric pressure, the same resilience would not be expected from them. The cells are the invention of Mr. H. Akroyd Stuart, whose name is associated with the Hornsby oil engine, and they cost about \$4 per set, according to the size of the wheel and the width of tire.—The Engineer.

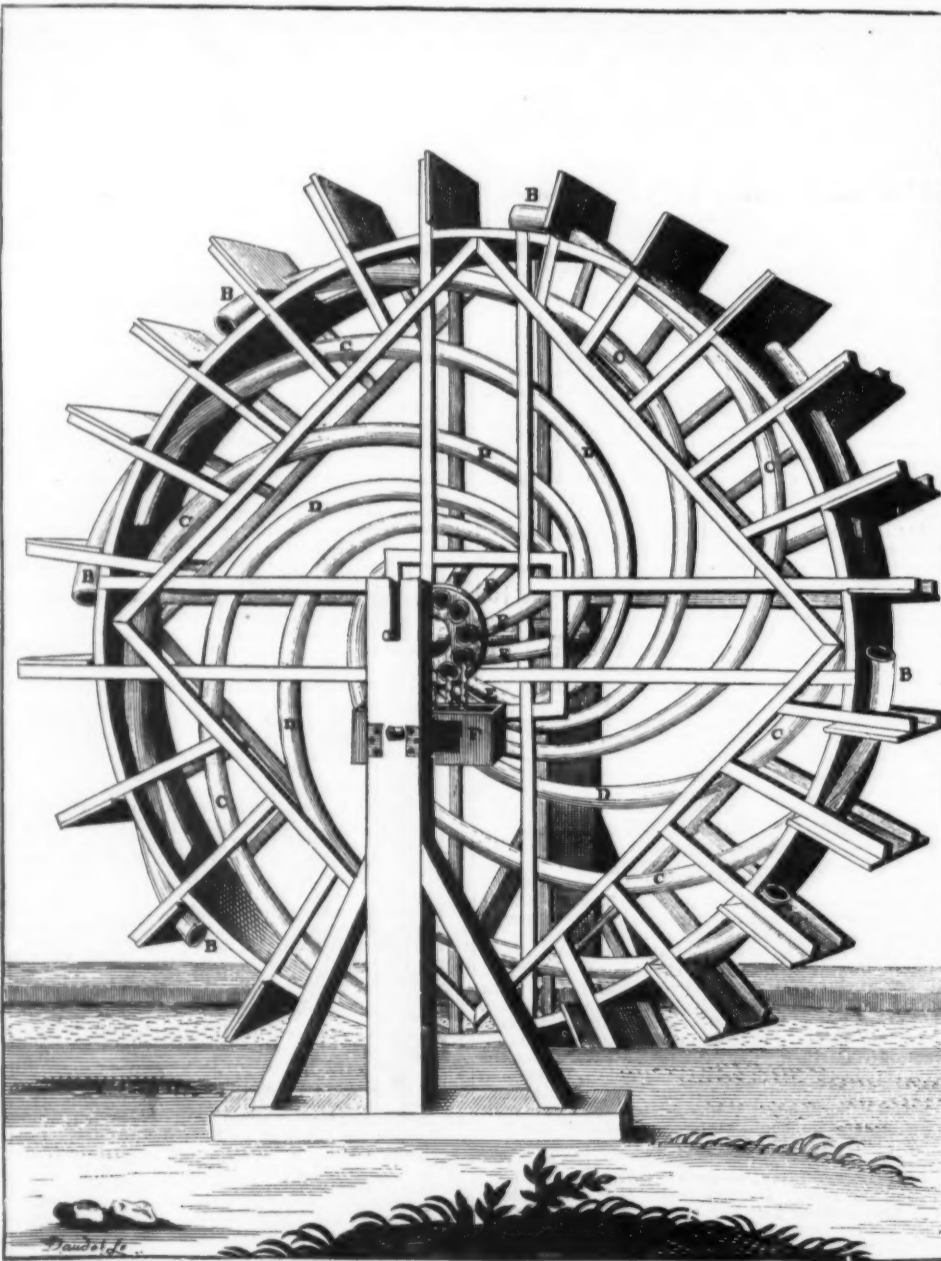
MACHINE FOR RAISING WATER FROM A RIVER TO THE HEIGHT OF A HALF DIAMETER OF A LARGE WHEEL, WITH BUT SLIGHT STRESS.

This machine consists of but a single wheel, that should be made of several pieces of wood, and be so carefully mounted upon its axis as to be in perfect equilibrium in all directions. This is not difficult, provided that, in its construction, there be used only pieces of wood of the same size and quality, and that, after it has been mounted upon its axis, care be taken to load the lightest parts so as to counterbalance those that are too heavy.

Afterward, there must be placed in the interior of this wheel the eight pipes of lead or other metal marked B, C, D, E, in such a way that they shall extend spirally from their mouth, B, to their outlet, E, that is to say, from the circumference of the wheel to its axle, along which they should curve.

The wheel is set in motion by the current of the river, through the paddles with which its circumference is provided, and, when it revolves, the parts, B, C, of its pipes pass in succession into the river and become filled with water through their mouth, B, but, since the latter, in following the wheel, always rises first, the water, no longer being able to make its exit where it entered, is obliged to flow along the pipes in always approaching the center of the wheel; or, to give a better explanation, when the part, B, C, that has taken up water rises, the liquid passes into the part, C, D, and, when the latter rises in its turn, the water that occupies it passes into the part, D, E; whence it flows into E, and then into the reservoir, F.

This machine is a very ingenious invention. It is constructed according to a certain principle upon which all mathematicians are agreed, and that is that the



MACHINE FOR RAISING WATER FROM A RIVER TO THE HEIGHT OF A HALF DIAMETER OF A LARGE WHEEL, WITH BUT SLIGHT STRESS.

equilibrium of a wheel can be altered only in proportion as the weight that it raises deviates from a line at right angles with its axis.

The water that the wheel, A, raises from its circumference to its center is so well conducted by the spiral arrangement of the pipes that it deviates but very little, as may be seen from the line perpendicular to the axis. Thus, it must be admitted that, since the equilibrium of the wheel is not much altered, the slowest stream is capable of making it revolve. Our engraving is from an old print in a curious work on the useful arts which was printed in 1733. It is entitled *Recueil d'Ouvrages curieux de Mathématique et de Mécanique*.

DOUBLE CROSSLEY GAS ENGINE AND DIRECT DRIVEN DYNAMO.

We illustrate by the engraving below, for which we are indebted to the Engineer, a new departure in direct driven dynamos, and what is, we believe, the first instance in this country of a large gas engine driving a dynamo direct. The engine is of the Otto type, by Crossley Brothers, and is of their two-cylinder end-to-end design. Both connecting rods, as will be seen from the woodcut, are connected to the same crank pin, and the engine is fitted with many special appliances to insure steady running.

The engine is of 60 nominal horse power, and, if working with coal gas, it would be capable of giving off 164 maximum brake horse power when running at 160 revolutions a minute. The crank shaft is cut out of a solid steel forging, and special attention has been paid to the length of the bearings, and an outer bearing and pedestal is provided to take the weight of the fly wheel.

The cylinders are 17 in. diameter, and the stroke 24 in. The dynamo spindle is coupled direct to the engine crank shaft by means of a flexible coupling. The base plates of the engine and dynamo are bolted together, so that the plant is self-contained. The dynamo is of Messrs. Siemens Brothers' H. B. type, and is designed to give 750 amperes and 100 volts at 160 revolutions a minute. The machine is shunt wound.

The engine has been specially designed to work with gas from Mr. Ludwig Mond's patent gas producer and ammonia recovery plant, an account of which has very recently been given at the meeting of the Iron and Steel Institute. This gas has now been used for a considerable time to drive one of Messrs. Crossley Brothers' 25 nominal horse power engines at Northwich, and has proved particularly suitable for the purpose on account of its being washed completely free from all dust and tarry matter; while it is, at the same time, much cheaper than any other gas of the same description, owing to common slack being used in the producers, and the recovery of the ammonia from the gas covers a notable part of the expenditure incurred.

The engine and dynamo which we now illustrate are intended to run an electrolytic installation at the works of Messrs. Brunner, Mond & Company, Northwich. Messrs. Crossley Brothers have recently supplied two engines of similar construction to the above for driving direct-coupled dynamos in connection with an electrical tramway abroad; and they also have three similar engines on order for the London County Council for driving centrifugal pumps at the new pumping station at Heathwall, Battersea.

THE SNAEFELL MOUNTAIN RAILWAY.

THE united systems of electric tramways in the Isle of Man are very interesting. The tramway system has its southern extremity at the foot of Victoria Street, Douglas. Here is the oldest section of the system and it still retains the original form of motive power, but the extension of the electric traction will not be long delayed. The tramway company's system consists of the Douglas Bay Tramway, which is at present operated by horses, its length is three-quarters mile; the Douglas and Laxey Tramway is an electric road, seven miles long. The Snaefell Electric Railway is also actuated by electricity, its length is four and three-quarters miles. The Upper Douglas Tramway is a cable road, three-quarters of a mile long. For our engravings of the Snaefell Mountain Railway and the foregoing particulars we are indebted to The Railway World.

In some respects the Snaefell section, the lower ter-

minus of which is not far distant from the tramway station at Laxey, is the most interesting part of the system of the Isle of Man Tramways Company. With the exception of the ill-starred Snowdon railway it is the only mountain line in the United Kingdom, but although termed a mountain railway, it includes no gra-

vision had been made for adequate transport facilities to Laxey, it was naturally regarded as an untenable proposal from a financial standpoint. As the tramway to Laxey drew near completion the urgency for the extension to the summit of Snaefell became so evident that Mr. Bruce and other gentlemen of local influence



SNAEFELL MOUNTAIN ELECTRIC RAILWAY—VIEW OF PERMANENT WAY AND MOTOR CAR.

dients of such severity as are generally associated with the popular idea of railways of this class. This fact, together with the character of track construction adopted and the powerful brake apparatus employed, removes any element of danger and renders an accident practically impossible. The construction of the

brought forward the scheme, and speedily set about its execution. The work was prosecuted energetically through the winter and spring of 1894-95, under the personal supervision of Mr. Fell, and in the summer of 1895 the line was opened for traffic.

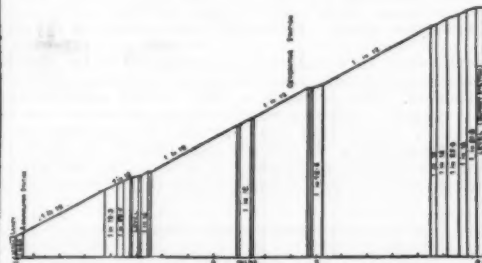
PERMANENT WAY.

The general construction of the track is shown in the illustration above. The gage is 3 feet 6 inches. The gage of all the Manx railways, as well as the Douglas and Laxey tramways, is only 3 feet, but it was thought best to give the mountain cars the extra width between the wheels in order to insure stability. Both tracks are laid with three rails spiked to cross sleepers of creosoted timber. The two outer rails are of the Vignoles flat bottomed section, of steel, weighing 50 pounds to the yard. They are fished in the usual manner, but provision is made for pounding by the use of Grover's spring washers on the fish plates, and the rails are electrically bonded with copper strips with double copper rivets. The center rail is made from the "Fell" pattern, and is of rolled steel, double headed, weighing 65 pounds per yard.

The center rail serves as a guide to prevent the cars from leaving the track, but it has no part in the traction, which is effected by simple adhesion. The middle rail also provides a surface for the grip of the emergency brake, with which every car is equipped in duplicate.

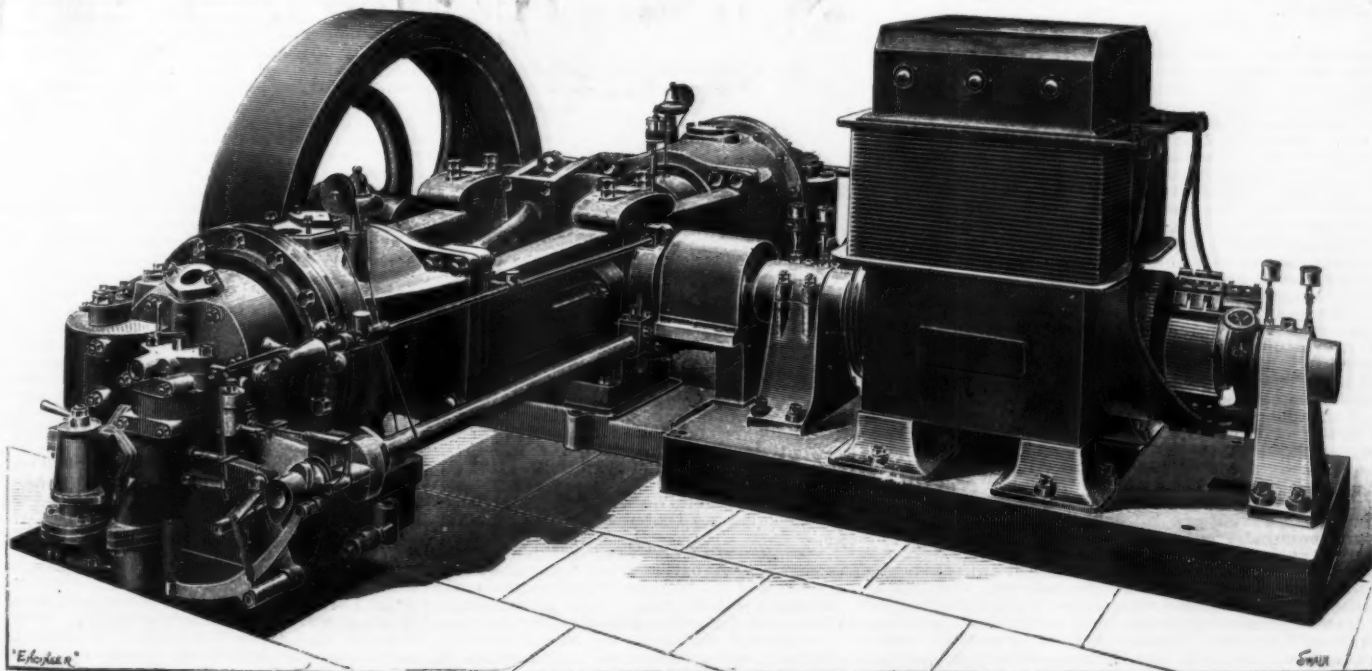
THE ROUTE.

The railway is 4½ miles in length from its starting point in the town of Laxey to its terminus at the summit of Snaefell, and for the entire distance there is a



SNAEFELL MOUNTAIN ELECTRIC RAILWAY—DIAGRAM OF GRADIENTS.

railway was due mainly to Mr. Alexander Bruce, the chairman of the tramway company. Although surveys were made as early as 1887-88 by Mr. J. Noble Fell, of Victoria Street, Westminster, and later on by Mr. D. Cregeen, C.E., these plans resulted in nothing, owing to the opposition of several landowners, and until pro-



DOUBLE HIGH SPEED ELECTRIC LIGHTING GAS ENGINE.

double track. For 3 miles, or two-thirds of the whole distance, the line climbs the hilly ridge which extends from the eastern side of the mountain to the coast of Laxey, forming the south side of the Upper Laxey Glen. In the remaining third of the distance the line ascends the mountain peak. The highest point of the mountain has an altitude of 2,034 feet, but the Summit station is 44 feet below, or at a height of 1,990 feet above sea level. The lower terminus of the line is 174 feet above sea level, giving a perpendicular rise of 1,816 feet to the Summit station. The ruling gradient is 1 in 12. For the greater part of the distance the tracks rest in cuttings in the face of the steep sides of the mountain, and a very large number of curves of from 600 feet to 1,320 feet radius have been necessary.

The Laxey station stands on the high road opposite the bridge that carries the road over the Mine Works to Ramsey, and thence passing along the south side of the Glen the line ascends the eastern ridge of the mountain for a distance of $1\frac{1}{2}$ miles, where it enters the unclosed mountain land at a height of 700 feet. At a distance of $2\frac{1}{4}$ miles from Laxey the generating station is passed, and soon after the train stops at the Snaefell station, 1,347 feet above sea level. From the Snaefell station to the upper terminus is a distance of $1\frac{1}{2}$ miles, and the vertical rise is 643 feet. To accomplish this ascent the line describes a complete circle, cutting the face of the mountain obliquely with a gradient of a little over 1 in 12. From the station on the south side the line goes round the western face of the mountain and then, passing to the north and east sides, crosses the peak to the Summit station on the south side at a height of 1,990 feet. The prospect as the train winds spirally round the mountain and approaches the summit is considered by travelers of widest experience to be unequalled by the view from any other point of equal altitude.

POWER STATION.

Power is supplied to the cars on the same system which is employed on the Douglas and Laxey line, and a detailed description is consequently unnecessary.

There is one power station, which is situated at a distance of $2\frac{3}{4}$ miles from Laxey at an altitude of nearly 1,400 feet above the sea level. This site was chosen as arrangements could be effected for securing a plentiful supply of water for the boilers. The source of supply is a small mountain brook 800 yards away, where a small pumping station has been constructed to raise the water to a tank close to the generating station. The tank has a capacity for storing water sufficient for three days' use.

The power station is a stone structure situated about 50 feet below the tramway line, but its chimney of wrought iron has been erected on the mountain side just above the line, and the furnace gases are carried beneath the tramway through a horizontal flue. The station comprises a boiler and engine and dynamo room. In the latter are four Lancashire boilers, each 26 feet in length by 6 feet 6 inches in width, giving 160 horse power each at 120 pounds pressure. The boilers can be fed either by means of a steam pump or by live steam injectors. The engine room contains five horizontal compound steam engines, each coupled by belt links to dynamos of the Manchester type. Both engines and dynamos were made by Messrs. Mather & Platt. The engines have cylinders 20 inches by 12 inches in diameter with a 16 inch stroke. Each dynamo running at 750 revolutions will develop 120 amperes at 550 volts, amounting to a total electrical output of 600 horse power. The engine room also contains a switchboard, with the usual accessories of voltmeter, ammeter, lightning arrester, and cut-out appliances. There is also a telephone box giving communication with each end of the line.

ACCUMULATOR STATION.

This is situated near the terminus at Laxey. It contains 246 chloride storage cells, each specially protected by means of asbestos cloth packing and by a special arrangement of the grid, to withstand a very high rate of discharge. The capacity of these cells ranges from 176 amperes for 3 hours to 72 amperes for 12 hours. The object of the storage is the same as on the Douglas and Laxey Tramway, to maintain an even pressure and in case of need to add to the capacity of the power station. As at the Groulle station, there are arrangements for charging the entire battery when necessary, but up to the present time the charge and discharge from the line has balanced, and the initial charge has consequently been maintained.

ROLLING STOCK.

The rolling stock of the Snaefell section consists of six motor cars with two trailing cars. Each car is 38 feet long, and will seat 48 passengers. They are entered by a door at either end through the motorman's cab, which is separated by a sliding door from the main part of the car. Each car is mounted upon two bogie trucks of 7 feet wheel base. The diameter of the wheels is 24 inches. Underneath each car there is a sand box provided with a system of pipes for distributing the sand under each wheel. The steel shoe brakes, controlled from both ends of the car, are applied to each wheel. The emergency brakes are likewise controlled from either end of the car. These are kept slightly in action during the descent, and when fully in action they will completely stop the car at once, whatever the speed attained. These brakes consist of two steel blocks or shoes, which grip the central rail. At each side of the central rail on the same level as the emergency brakes there are two pairs of horizontal idle wheels mounted on spindles. The wheels of each pair of these center wheels just clear either side of the double-headed guide rail, and their flanges pass underneath this rail. The stout flanges of the guide wheels thus prevent the trucks from mounting the traction rails, and make it impossible for the car to leave the track. Each car is provided with four 35 horse power Mather & Platt motors, so that each axle is geared to a motor, and every wheel is a driving wheel. Single reduction 4 to 1 gearing is employed.

The motors are worked at 500 volts, and are connected together two and two in series, when a normal current of 120 to 160 amperes will pass through each car. Owing to the few stops required, the cars are not provided with a series parallel controller, and resistances are placed beneath the car. The start is made by putting these into circuit, and as the speed rises gradually cutting them out. The supply of current to the motors is thus left to the discretion of the motorman. A tractive

effort of 3,000 pounds is required to propel these cars at an average speed of nine miles per hour.

As in the case of the Douglas line, Messrs. Mather & Platt were the contractors for the entire generating station and storage plant, and for all other electrical equipment both of the line and the cars; and to the skill and care with which the installations have been planned and carried out is due in a very large measure the success which has attended the operations of the tramways since their completion.

THE QUANTITATIVE ANALYSIS OF METALS BY ELECTROLYSIS.

IN 1838, Jacobi recognized the fact for the first time that an electric current, traversing a solution of a salt,

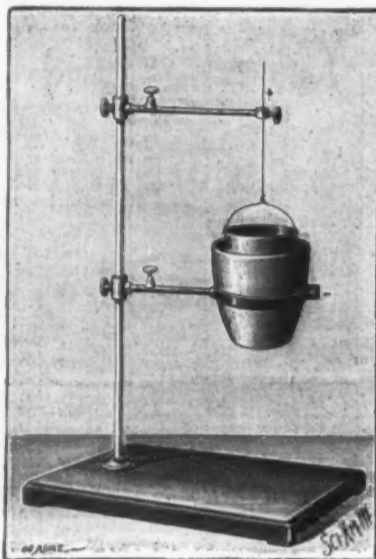


FIG. 1.—RICHE'S ELECTROLYTIC APPARATUS.

decomposed the latter and set the metal free and allowed it to deposit upon the negative electrode. He almost immediately saw the practical side of the discovery, and, under his powerful impulsion, the industry of electro-metallurgy was quickly created. But it is not more than twenty years ago that the idea occurred to utilize electrolytic decomposition for the quantitative analysis of metals. In order to know the composition of a material, it is necessary to be able to determine the nature and proportions of its constituent elements. This problem is more or less easily solved by taking a definite weight of the substance to be studied, separating its various components and weighing them. If the galvanic deposit is adherent and the cathode upon which it is produced has an appropriate form, electrolysis permits of ascertaining the

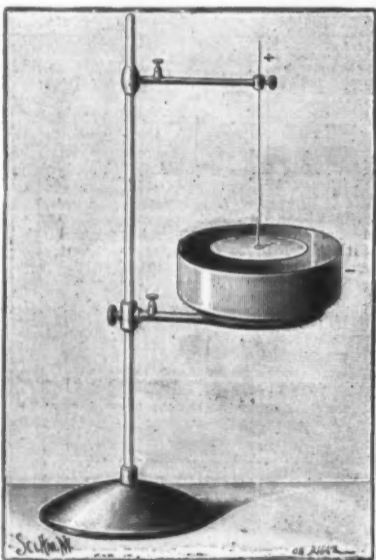


FIG. 2.—CLASSEN'S ELECTROLYTIC APPARATUS.

quantity of metal contained in a liquid. It suffices to tare the electrode before causing the current to act, and, after the action has terminated, to transfer it to the scales in order to ascertain the increase in weight due to the metal deposited.

Copper was the first metal quantitatively analyzed in this way. Gibbs thought that it might be possible to precipitate it from a cupreous solution by means of electricity. To the liquid placed in a platinum capsule he added some zinc. A battery formed, the zinc seized upon the acid, and the copper deposited upon the capsule, forming a positive pole. As for nickel, cobalt, iron, and almost all the common metals, they were successively precipitated, thanks to the researches of numerous chemists, among whom we may mention M. Riche, of Paris, and M. Classen, of Aix-la-Chapelle. The electrolytic determinations are made by means of

a current produced by a special apparatus. For the reception of the deposit, there are employed platinum cathodes of varied forms. In the most widely used apparatus there is employed either a cylinder or a capsule in which the liquid is placed. The arrangement usually met with in laboratories is due to Messrs. Riche and Classen.

M. Riche's apparatus (Fig. 1) consists of a platinum crucible into which is inserted a cylinder of the same metal, open at the bottom and following the contours of the crucible. Between these two parts there is a space of a few millimeters. A glass support carries two movable arms that serve to hold the crucible and cylinder. Two terminals permit of connecting them with the poles of the apparatus that produces the current. The deposit takes place upon the cylinder.

In M. Classen's apparatus (Fig. 2) it is upon the platinum capsule serving as a receptacle that the metal deposits. The current enters the liquid through a rod ending in a disk. A support analogous to the preceding holds these two pieces and permits of connecting them with the generator of electricity. This arrangement is more advantageous than the preceding. It is not so heavy and is, consequently, less costly and permits of easily operating upon a greater volume.

Since, in some operations, it is necessary to act at about 60°, the Classen apparatus is completed by a gas burner of very small size. Electrolysis presents the great advantage of proceeding automatically. The operator has only to set the reaction in operation and to arrest it. During the entire duration of the decomposition his time is his own, and he can devote himself to other duties without his work suffering in the least from it.

Certain precautions are necessary for carrying on an operation of this kind successfully: (1) It is necessary that the metal shall be in a certain state of combination, all salts not being adapted for obtaining a beautiful metallic deposit. The oxalates and lactates give satisfactory results with almost all the metals. The sulphates, nitrates, cyanides and double sulphides are also precipitated. (2) The strength of the current is of importance, for in order to effect an electrolysis it must not fall below a determinate electromotive force, say one of 2 or 3 volts. The intensity is not an arbitrary matter either. A feeble current produces a slow decomposition, and too strong a one gives a granular deposit that does not adhere to the support. The intensities employed vary from 0.5 to 3 amperes, according to the bodies. In careful installations, there is introduced into the circuit a commutator connected with a voltmeter and an ammeter in order that the behavior of the current may be known at every instant.

Analysis by electrolysis gives quick and extremely accurate results. It is naturally applicable neither to the alkaline nor to the earthy alkaline metals, but it renders appreciable services in the quantitative analysis of the majority of the metals employed in the arts. It is possible by this method to analyze the compounds of the following bodies: iron, cobalt, nickel, zinc, cadmium, copper, mercury, silver, gold, antimony, bismuth, arsenic, platinum, palladium, tin and thallium. Lead and manganese may also be precipitated by the current, but they deposit, not in the state of metal, but in that of binoxide at the positive pole.—*La Nature*.

ELECTRIC LIGHTING OF RAILWAY TRAINS ABROAD.

IN the course of the past two years many notices have appeared in the foreign electrical journals bearing on the favorable results obtained in lighting railway passenger trains by electricity. By reason of the large interest which railway companies have in securing efficient and economical lighting for their cars, it may be expected that the publication of the notices just referred to may be followed by the adoption of electric lighting for passenger cars on a very extensive scale. Under these circumstances a short account of the development of this branch of electric installation work cannot be without interest to transportation companies and the traveling public generally.

As might be supposed, the first illuminants used for train lighting were oils, petroleum being the one most generally adopted. Candles were used simultaneously to a considerable extent. In 1868 an experiment was made in lighting trains by gas, but this was not successful. It was only in 1871, when Pintsch had invented the "regulator," which brought the ninety pound pressure of the gas in the receiver down to that necessary to sustain a column of water one and a quarter inches high, which is the pressure used at the burner, that gas lighting became practical. England began to use gas for lighting railway cars in 1876, but this work was purely tentative. This system was not developed on a large scale until 1880. In the next seven years, though, very great strides were made, so that in 1887 we find over thirty thousand cars in Europe equipped with gas lighting apparatus. Of thirty thousand, Germany alone had fifteen thousand and England nine thousand cars in operation.

In looking up railway lighting statistics for 1894 in Germany (not including Bavaria) we find that of all the railway passenger cars in operation eighty-five and four-tenths per cent. were lighted by gas, ten per cent. by oil and four and six-tenths by candles. At the same time there were only thirty-five passenger cars and four hundred and fifty postal cars lighted by electricity. The explanation of the small number of cars lighted by electricity is not far to seek—German railway corporations having expended a great deal of money in introducing gas lighting into their cars, are not prepared to change the present system to one of electric lighting.

In the first experiments made in England and France in lighting trains by electricity primary batteries were utilized as the source of electric power. As can be surmised, these experiments were not a flattering success, on account of the trouble and expense of maintaining the batteries.

In 1881 a Pullman car on the London-Brighton Railroad was equipped with a storage battery, which was utilized as a source of electric power in lighting the car. When, however, it is remembered that it was only in that year that Faure first took out his patent; that accumulators were introduced at once into the arts, i. e., before they were commercially a perfect article; that the manufacture of storage batteries was costly during

their incipency, it can be understood that the first trials with a storage battery were not successful. The reasons therefor are apparent.

Electricity may be generated, for use in lighting trains, by operating a dynamo from a belt running on the wheel axle, or by a gear mechanism. The advantages of this system are neutralized by the complexity rendered necessary when such an arrangement is employed. Any efficient system of lighting must be independent of the direction and speed of the train; and the lighting must be continuous even after the train stops. Obviously a system where the car axle is the motive power, which is transmitted to a dynamo with no storage capacity and but a small range of regulation, cannot meet the demand for continuous and economical lighting.

For some time the solution of the above problem has been the objective point of many a capable electric engineer. Moreover, many railway corporations have had their own laboratory staff working on it. Where other countries have failed in working this problem to a successful conclusion England has been successful. In England a system has been perfected by Messrs. Strondley and Houghton, of the London-Brighton Railroad Company, and Mr. Langdon, of the Midland Railroad Company. The first-named company, which applied the system to sixteen trains in 1890, has now applied it to forty trains, or four hundred cars in all.

The following is a description of the system used for maintaining the voltage of the dynamo constant during the different speeds of the train. Two dynamos are used; one for lighting, the other for regulation. Both of these are placed on the same shaft, which is moved by a belt running on the car axle. The magnets of the two dynamos are energized by a storage battery, each by a special circuit. The armature of the regulating dynamo is connected in series with a special winding of the magnet in such manner that the E. M. F. developed in the armature is opposed to that of the battery. At high speeds the magnet of the light machine is energized by a winding possessed of high resistance and which is connected with the battery. Through the second magnet winding no current passes, because the regulating dynamo gives a high voltage opposite to that of the storage battery. As the speed of the train diminishes, the voltage of the battery preponderates over that of the regulating dynamo, and in consequence, a current passes through the second magnet winding of the light dynamo and energizes its magnets. Under such conditions the voltage of the main dynamo will rise; but inasmuch as the speed of the train is less, that of the armature is less. Thus an equilibrium is produced, which keeps the voltage constant. When the speed of the train falls below a certain point, an automatic cut-out switches the dynamo out of the circuit. As the train regains its speed, the dynamo is again thrown into circuit.

On the trains of the London-Brighton road one battery does the regulation for a whole train. On the Midland Railway Company's trains the installations possess the same features as cited above, except that there is a battery on each car.

In Germany also, in 1886, a similar arrangement, according to Loebbecke and Oestreich, was made on a train running between Frankfurt and Fulda, and on another between Stuttgart and Immendingen. In this case the revolutions of the armature of the dynamo machine were kept constant by means of a centrifugal regulator which moved a belt on two cones. When the speed of the train sank below a certain point the regulator moved a switch, throwing the dynamo out of circuit; the accumulator in parallel with the dynamo takes care of the lighting while the dynamo is out of circuit. With a higher speed the machine was again switched in. This system, however, was not considered practical, and after a few months' trial was abandoned.

About this time the Wurtemberg "States Railroad" permitted the Cannstatt Electrotechnical Manufacturing Company to equip a train after the method proposed by Professor Dietrich in Stuttgart. In each car there were two batteries, one of which was used to operate the lamps while the other was being charged. When the former gave out it was put into the charging circuits and the freshly charged battery was put in its place. If the speed of the train became so slow that the electromotive force of the dynamo was not sufficient to charge the battery the dynamo was switched out of the charging circuits by an automatic cut-out. As the speed increased the dynamo was in a similar way cut into the charging circuit. This system had the merit of being able to furnish a very constant light; but, in point of view of first cost, was too expensive.

Simultaneous with the attempt to secure electric illumination by means of a dynamo worked from the car axle, a peculiar installation was made in England in which a special steam engine, taking its steam from the locomotive, was used as motive power. The North-western Railroad introduced this system on a train in 1884. A little later the Lancashire and Yorkshire railroads made similar experiments. It is evident that these installations are expensive to operate, and that the first cost is high.

The most expensive kind of installation of all is one which includes boiler, engine, dynamo, and accumulator. Up to the present this system has only been used on a few luxurious trains, as those of the Austrian kaiser and of the Russian czar.

In Denmark and Sweden we find still another system in which one storage battery is placed in the first car and another in the last car. The electro-motive force employed is fifty, sixty-five, or one hundred and ten volts, according to circumstances. The voltage is regulated by means of a cell switch controlled by hand. This system can only be used on trains which remain "closed;" a wire contact, moreover, is necessary between the cars. Throughout all of Europe this is not feasible, because at certain stations the cars of one train are taken out and placed in another, others being in turn substituted or not, as the case may be. Generally speaking, the only conditions under which this system could be used would be those in which each car possessed its own battery. The battery jars are arranged in boxes and stowed out of the way, usually in the same part of the car containing the gas holder. When a battery is discharged the boxes are removed to the station for charging, fresh boxes of cells being put in their place. These batteries are so made as to be capable of being charged at high charging rates—say

in one hour. The positive plates of the new Tudor accumulator are made with a very large amount of surface, making it possible to use large currents in charging. Such cells can be charged in a very short time.

If the batteries are to be charged in the stations along the road, then only enough cells are put in one box as to constitute a load for one or two men.

There are numerous ways of connecting in the batteries on the lighting circuits; these need not be specified. The instruments on this circuit are: (1) The main switch, (2) the main safety fuse, and (3) the Aubert indicator, which shows the length of time the lamps have been burning. A safety fuse is frequently employed on each lamp, and sometimes a switch for varying the intensity of the lamp. The lamps used are of different resistances, requiring sixteen, eighteen, twenty-four and thirty-two volts. To simplify the management, all cars have the same type and size of battery. If two batteries are in one car, then the batteries work in parallel, or each one has its own circuit. The last case is the more desirable one.

The current required for charging the accumulators is furnished by the dynamos which are used to light the stations. The Italian railroad (the Novara Seregno-Sarano) accepted this system for fifty-three cars in 1888. More than two hundred cars are lighted in the same way on the Jura-Simplon Railroad in Switzerland. On the French Northern Railroad fifty cars are supplied with chloride accumulators. In Germany over six hundred postal cars are supplied with this system of lighting, which finds additional support in England, France, Hungary and Roumania.

Electric lighting for cars is to be preferred, not only because it is sure and free from danger of causing fire, but because it is the most pleasing kind of light. Candle power for candle power, the weight of the apparatus for electric lighting is decidedly less than that used for gas lighting. The following table shows this:

1	2	3	4	5	6	7	8	9	10
Railroad.	Watts per Candle.	Candle Power per Battery.	Weight of Battery, Pounds.	Weight of Battery Box, Pounds.	Total Weight, Pounds.	Cubic Feet of Gas.	Capacity of Gas Holder, Cubic Feet.	Weight of Gas Holder, Pounds.	Excess of Weight of Gas Holder over that of Battery.
Jura-Simplon	3	730	232	110	342	370	55	530	p. c.
Frankische Nordbahn	3	1250	528	350	878	488	97	990	50
Dortmund-Gronau	2½	1000	440	154	594	400	80	702	30
Kaiser Ferdinands-Nordbahn ..	3	3300	946	374	1320	1300	240	1080	50
Rheinpostwagen	3	1200	462	110	572	400	62	994	60
Danische Staatsbahnen auf Jütland	2½	1400	690	220	910	525	105	1100	25

Experience, moreover, shows that even in regard to the cost of lighting, the electric system is better than the gas system; in other words, it is cheaper to light cars by accumulators than to use gas.—The Car.

MILK AND SOME OF ITS PRODUCTS.

By JOHN CROWELL, M.D.

MILK is the most popular, the most simple, as well as the most nutritious of any of the articles of food used by the great mass of human kind. It is easily attainable, and it contains the necessary elements for sustaining life. This is especially true of cow's milk, containing carbon, oxygen, nitrogen, and hydrogen, combined in fairly equal proportions in the form chiefly of water, casein, albumen, fat (or butter), lactose, and numerous salts. Having these chemical qualities, it is possible to sustain life for a long time upon an exclusively milk diet. This, however, soon becomes wearisome, and gastro-intestinal derangements are apt to result after a few weeks. In this exclusive use, there often follows a disagreeable nausea, and the smell and taste of the milk causes great loathing.

This disagreement is caused from the fact that there is too much nitrogenous matter in proportion to the carbohydrates, and in order to obtain sufficient carbohydrates, too much protein is taken, which greatly interferes with the process of digestion. But, although an exclusive milk diet seems essential in the first years of human life, it is not sufficient for adults. It is usually omitted from the dietary of athletes in process of training, and in many persons it causes derangement in digestion, resulting in constipation and other disagreeable conditions.

On the other hand, it is often used with the most satisfactory results in cases where no other form of diet can be tolerated, and in almost any febrile condition its use is of the first importance, especially where the nitrogenous metabolism is great. The time required for the complete digestion of milk, in its normal process, is three hours. Oftentimes the milk of the cow disagrees with the stomach, and, especially with infants, cannot be tolerated. This is owing to a variety of causes, as contamination by disease germs from the cow, poisonous foods eaten by the cow, extraneous disease germs, pollution of the milk by the dealer, souring or decomposition of the coagula formed in the stomach, when the gastric juice fails to disintegrate the casein within a reasonable time, owing to the weak state of that organ.

Whenever, therefore, a child is unable to retain the milk that is ordinarily given to it, inquiry should be made into the sources from whence the milk is obtained, and it will often be found that the trouble lies with the habits of the cows. These animals, especially in the dry weather of late summer, often seek low places in the meadows and eat poisonous herbs and grasses, and sometimes the simple change in the character of the feed will be a sufficient cause to affect the milk and render it unfit for use.

The most evident differences between human and cow's milk are that woman's milk is sweeter, it contains less butter and casein, and the casein forms in much smaller clots and is more quickly dissolved. The milk of the mother is normally alkaline, while the reaction of cow's milk varies, and it may be acid.

Goat's milk, because of its richness in fat, disagrees with many, occasioning nausea and vomiting. Its disagreeable odor is also objectionable, and infants do not

thrive under its use. Mare's and ass's milk contains less nitrogenous matter and fat and more sugar than cow's milk—that of the ass being very sweet and easy of digestion, although it sometimes causes diarrhea if taken alone. When milk is boiled, a thin scum of albumen appears upon the surface, which, when removed, is quickly replaced by another. Boiling expels about three per cent. of gases, and the loss of oxygen diminishes the formation of lactic acid, and consequent souring. It somewhat affects the taste of the milk, and its use for any length of time produces constipation.

Should raw milk be given to infants?

This question has given rise to much discussion, and high authorities sharply differ upon the matter. We certainly know that, in many cases, pure milk does no harm, and that children thrive upon its constant use. Boiling the milk arrests the development of germs and fungi, with which it may have been contaminated, and thus it may prevent occurrence of certain diseases, and the process of souring and coagulation is certainly retarded by boiling.

The quality of milk depends largely upon the breed and proper care of the cows. Much neglect in this direction is common among the producers of milk. There should be absolute cleanliness in handling everything belonging to the care of the herd, as well as in the process of milking and the use of the vessels for receiving the lacteal fluid. Sometimes the milk is put at once into glass bottles, tightly corked. The pails and cans should be carefully washed, and often insured from germ poisoning by scalding with boiling water. In large establishments, there should be an inspection of the sanitary surroundings, either by a physician or by an expert in hygienic science. The condition of the yards and stables should be thoroughly inspected, and care should be taken that the animals are not fed upon swill and garbage, and that certain kinds of food should be avoided, especially such substances as will give to the milk a disagreeable odor, like garlic, cabbage, etc. It has been suggested by good authority that there may be danger of tuberculous disease by drinking milk from cows having "pearl disease," which is believed to be analogous to tuberculosis, but there is really no authentic case where this result has been produced in man, although lower orders of animals are thus infected. This is a matter for further investigation, for certainly the milk of animals having the above named disease is below the normal standard of nutrition.

The inspection of milk by legal authority is of great importance, and in many States the requirements are specific. In New York, the specific gravity is ascertained by the lactometer; in Massachusetts, Rhode Island and Maine, a chemical analysis is required. The normal average specific gravity allowed is 1.030+.

The total quantity of solids in milk should, according to Lethely, amount to fourteen per cent. Such inspection has been made necessary because of the adulteration of this important article of food. The most popular and simple form of adulteration is the addition of water. In order to give the milk a thickened look, after this dilution, chalk or flour is sometimes added. Bicarbonate of sodium and salicylic acid are often added to prevent souring. If milk inspectors are honest men, and understand their business, it is a very easy matter to detect any of these base frauds upon the public.

The most popular products from milk are butter and cheese—those well known condiments and appetizers all over the world. Cheese is the separated casein of the milk, and it forms a highly nutritious article of diet, and, in some countries, where meat is scarce and dear, the people consume large quantities of cheese, to supply the nitrogenous elements of diet, using the heavy and less highly flavored of the cheeses. The wealthier classes use as a condiment the more highly flavored cheeses, such as the Roquefort, Edam, Cheshire, etc. Taken in moderate quantities, these cheeses aid in promoting digestion, and are very palatable to the epicure.

Butter is made from cream by the mechanical rupture of the albuminous follicles which inclose the fat globules, which then adhere together into small masses. Butter contains six neutral fats, four of which, being volatile, give to it taste and odor. The adulteration of butter is accomplished by dealers, by beating it up with water, and by adding other fats, especially suet and oleomargarine. Butter will not support life for any considerable length of time when taken alone. Taken in connection with other food, it is a highly digestible and nutritious, and often fattening food.

Fermented or "rancid" butter causes violent gastric derangement, and it is therefore important that it be thoroughly worked with a spatula, and frequently washed, and seasoned with at least two per cent. of salt. In California they have an ingenious way of ridding butter of a rancid taste, by subjecting it to the action of an electric battery. The butter is melted in a tub, and the poles of an electric battery, incased in flannel, are placed in it, so that a current of electricity when passed through the butter from one pole to the other determines a collection of the acids which caused the rancid taste at one or the other pole. In striving to reach the pole, the acids sink into the flannel and may thus be removed.

Condensed milk, which is so much used for the food of infants, is prepared by slowly evaporating the water of milk by moderate heat. There are two varieties, the plain, which is condensed to about one-fourth of its bulk, and superheated, and to which no sugar is added, and the stronger variety, which is more condensed, and to which cane sugar is added in excess, yielding about forty-five per cent. of sugar among its solid ingredients. This excess of sugar prevents the decomposition of the milk, and it will keep fresh for many hours after the can has been opened.

Condensed milk, because of its convenient form, is used largely among the poorer classes, and infants seem to thrive well for a time. But, although they often grow fat, they develop poorly, and are less able to resist disease than children who use the pure milk.

According to Heubner, condensed milk has been used successfully in dysentery, and is a preventive of that dreaded disease of summer—scoury.

Koumiss is another form in which milk is prepared for dietetic and medicinal uses. This is a fermented milk, prepared in a peculiar way, and used largely by the Russians. It is mildly stimulating, and sometimes intoxicating, and is used in cases of phthisis and intestinal derangements, and other wasting diseases. Its virtues have, no doubt, been exaggerated, the cures having been due more to the favorable climate along

the steppes of Russia, where the patients under treatment resort, than to the curative qualities of the specific. The koumiss has been introduced into this country, where its curative qualities have been highly lauded. It is strongly diuretic, quenches thirst, increases the cardiac force, improves the muscular tone, aids general nutrition, and beautifies the complexion.

This preparation is made from cow's milk, by various firms in the United States, and preserved in glass bottles, but it does not contain the peculiar flavor and the essential qualities belonging to the native article, which is made from mare's milk, and kept in smoked-out leather bottles, and subjected to various manipulations which cannot be imitated, even by Yankee ingenuity. —Popular Science News.

SUNSTROKES.

DR. IRA T. VAN GIESEN, on August 31, gave a careful summary of the experiments into the nature of sunstrokes, carried on during the recent hot spell. He is the director, says the New York Evening Post, of the State Pathological Institute, now being fitted up on Madison Avenue and Twenty-third Street, New York City, to be run in connection with the State hospitals. Its purpose is to make possible a special experimental study of insanity. Dr. Van Giesen said to-day that although he had not made an extended study of the literature of sunstroke, he was under the impression that it had not before been studied from the standpoint of physiological chemistry, but had had very little attention from the medical world.

"The first reason for undertaking this investigation," said he, "was that this institution was started for the investigation of insanity on the physical basis. A large number of sunstroke cases eventually find their way into the asylums. The recent hot spell furnished us with abundant opportunities to work up the subject from the standpoint of physiological chemistry."

The doctor then gave the experiments, which at least suggest that sunstroke is in nature autotoxic, or caused by poison from within the body. If future experiment confirms this suggestion, the practical benefit, he indicated, would be the probability that the disease could be avoided by drugs or other materials given ahead to counteract the poison, the nature of which is thus far unknown, but likely to be discovered with further experiment. The series of experiments on which the theory rests are, in the doctor's words, as follows:

"In the first place, the urine was taken from cases immediately after they were brought into the hospitals and shortly after they were stricken, and injected in given weights into the ear veins of rabbits. It proved to be hypotoxic, or less poisonous than it should be in normal cases. A perfectly normal human being secretes enough poison in twenty-four hours to kill himself, and if a given amount, say 50 cubic centimeters, of a normal man's urine is injected into a rabbit weighing say 500 grammes, it is sufficient to poison him in a given time. The urine from these sunstroke cases could be given in much larger amounts than in normal cases without poisoning, showing that something was retained in the body which should have been excreted, thus conforming to the fairly well-established principle that in auto-intoxications, or the circulation in the blood of poisons derived from the interior of the body, the urine is less poisonous than in health, because in health it constantly excretes substances which if retained would be noxious.

"We were thus led to seek the presence of poison in the blood and the cerebro-spinal fluids taken in cases of sunstroke immediately after attack. Four rabbits were infected with these fluids and died in the night when their symptoms could not be observed. Then Dr. Lebonitillier in two cases at the Manhattan Hospital took five ounces of blood and set it on the ice box overnight to allow the serum to separate. By injecting from ten to fifteen cubic centimeters very uniform results were observed on four sets of animals. Within fifteen minutes after the injection in the ear vein the temperature rose two degrees in the rectum, and within forty-five minutes to an hour and a half the animals exhibited a very severe form of convulsions, and the animals quite regularly died in the midst of the attack, in from three to five minutes."

This last experiment is the one the doctor relies on especially to show the presence of a virulent poison in the blood in cases of sunstroke, but he says many more experiments must be made to give the hypothesis cer-



FIG. 1.—VIEW OF THE SEBASTOPOL GALLERY OF THE PARIS SEWERS.

their work and getting rid of the retained poison. The cases that did not convalesce were generally those of people with alcoholic histories, and their kidneys and livers were in such condition that they could not get rid of the secretions."

The doctor spoke enthusiastically of the commission of lunacy and of the wisdom of having the Pathological Institute in the city, where such cases could be studied immediately. He said that the place to study insanity was in its incipient states, in the great common diseases like typhoid fever and sunstroke, and in conclusion he praised highly the doctors in the hospi-

the city and to the judicious proportions of the work of Belgrand, traveling in the sewers, at least in the large collectors, constitutes, on the contrary, an excursion that presents nothing disagreeable and that is certainly less sad and perhaps more curious than a visit to the catacombs of Paris.

The enormous volume of water in which the filth is diluted, the swiftness (3 feet a second) with which the water flows, and the active ventilation produced by the mouths of the silt basins and by various other openings, prevent the atmosphere of the sewers from being as deleterious as might be supposed a priori. It

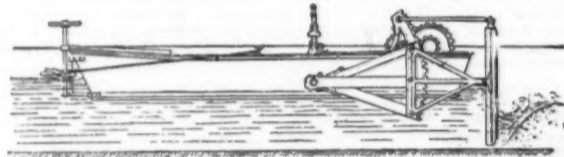


FIG. 3.—IRON BOAT USED IN CLEANING THE SEWERS AND CARRYING PASSENGERS.

tals and the coroners for the help they had given in this investigation, saying that the amount of work done by the physicians during the hot spell was enormous.

VISITING THE SEWERS OF PARIS.

CONSIDERING the enormous quantity of filth of all kinds that the broom of the street sweepers throws into the sewers through the mouths of the silt basins under the edge of the sidewalks, one might be tempted to believe that these tunnels constituted cesspools difficult of access and of insupportable odor. It might seem as if the cleanliness of Paris was obtained only through the creation of rivulets immersed in darkness

is possible to stay an hour or longer therein without being in the least bit incommode, and the most sensible impression that one perceives is a sensation of humidity and coolness. In fact, a stay in a large collector whose temperature varies between 10 and 15 degrees only gives almost the same impression as a somewhat prolonged stay in a damp cellar or a deep cave.

Proud of its system of sewage and desirous of showing the perfection with which it operates, the city of Paris has organized visits in which any one may participate by applying to the prefect of the Seine. These visits take place during the season beginning with April and ending in October. The trip effected on such occasions is comprised between Place du Châtelet

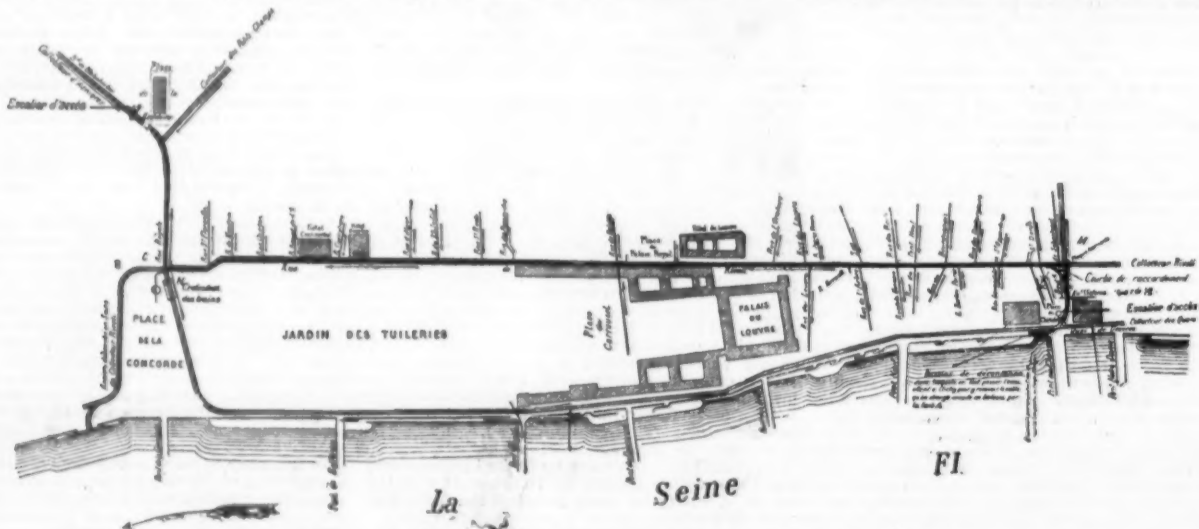


FIG. 2.—PLAN OF THE ITINERARY FOLLOWED IN VISITS TO THE SEWERS.

tainly. "Another set of experiments was carried on," he continued, "by injecting the urine into the ear veins of rabbits during later periods, after cases of sunstroke. It was found that in from six to twenty-four hours the urine becomes toxic again and the cases recovered, which meant that the eliminative organs were doing

and circulating a foul smelling liquid. It would appear as if traveling about in these galleries ought to be reserved solely for the agents having their surveillance in charge, and that a trip by boat over the polluted water could hardly be considered as a pleasure.

Thanks to the measures taken by the engineers of

and the church of La Madeleine, a total length of a little more than 1½ miles, 890 feet of which is in the Sebastopol collector, 7,870 in the Rivoli collector and 1,640 in the Asnières collector (Fig. 2). The trip is made in two parts. In the first two collectors it is effected through cars running upon a track of 4 feet gage, while

in the Asnieres collector it is effected by means of boats. At the junction of the Rivoli and Asnieres collectors there is a crossing station. The travelers arriving from La Madeleine land upon the foot bridge, N, while those coming from Chatelet get out of the car and take the boats abandoned by the first. The latter afterward enter the cars, which take them to Chatelet. One hundred passengers are carried upon each trip, and as there are three trips a day in each direction, that makes 600 visitors a day, say 8,400 for the fourteen annual visits.

The material for the visits comprises nine special

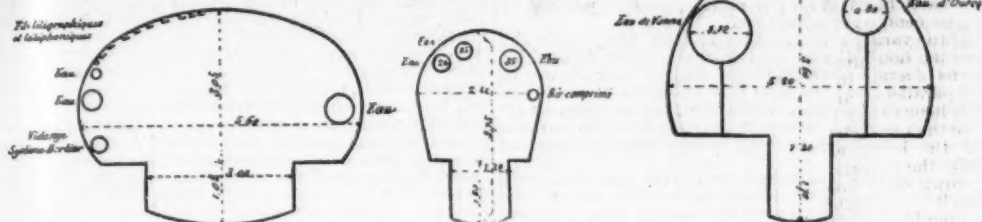


FIG. 4.—SECTIONS OF THE SEBASTOPOL, ASNIERES, AND RIVOLI COLLECTORS.

cars and six boats arranged for the occasion at every visit. These boats are merely the ones usually employed in the cleaning of the sewers (Fig. 3). As for the cars, they are especially constructed for the reception of the visitors. They run upon the track placed over the draining ditch and designed for the running of the cars employed in the cleaning.

Up to 1894 all this material was drawn by men, each car requiring four laborers and each boat fourteen or eighteen. The fatigue experienced by the laborers was so great that it was necessary to relieve them at the second turn. The expense was also excessive, and the city engineers therefore decided to adopt mechanical propulsion.

In 1894 the first electric locomotive was delivered by Messrs. Breguet & Company, and, in 1895, a second locomotive identical with the first was put in service.

lass and towing pulley. The energy that it absorbs in normal operation is but 25 amperes under 65 or 68 volts, say 1,600 watts, that is, nearly a third of the power necessary to run the large boat at a sensibly equal speed.—Le Genie Civil.

OPEN HEARTH FURNACES IN GLASSWORKS.

THE majority of the glassworks that manufacture bottle glass, window glass, and glassware even, are now replacing the pot furnaces that they formerly employed by hearth furnaces, whose entire role serves as a

luminous heat. It can become heated only by conduction from the surface of the bath, and it is, therefore, necessary that the latter shall be of slight depth and that the gaseous flame that is to heat it shall be of slight thickness. One is, therefore, led in such a case to adopt a hearth of slight depth and at the same time to lower the dome in giving it the minimum height to assure good combustion.

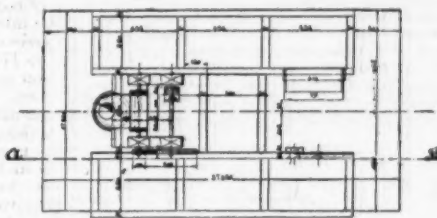
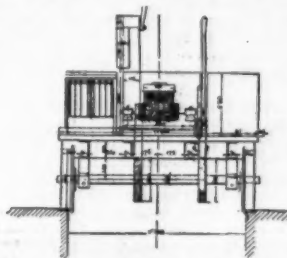
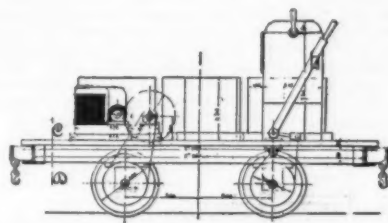
The same is not the case when we operate upon glass in fusion, especially window glass, which is colorless and more diathermanous than bottle glass. The bath is then a bad conductor of heat, but allows itself to be traversed only by luminous heat, which it succeeds, in a manner, in imprisoning. This heat is transmitted in a straight line, and, without sensible waste, traverses the molten bath and produces fusion throughout nearly the entire thickness. Were it not cooled, it would even come into contact with the sole, which would dissolve in the bath. This, indeed, was what occurred in the first furnaces of slight depth. There was required an energetic cooling that it was difficult always to maintain at the degree necessary to prevent the attack of the hearth, while in the new furnaces one succeeds in maintaining the bath at the bottom in a solely pasty state by reason of the inevitable absorption of heat that occurs in depth. The hearth is, therefore, protected by cooling it externally by a simple circulation of air. What gives great likelihood to this explanation is that, in bottle works where the glass is less diathermanous by reason of the color that it possesses, the fusion is not carried to so great a depth.

The theory that we have just summarized gives an explanation of the characteristic differences presented in glass furnaces as compared with steel ones, and it shows, too, the advantage of giving them a high dome with a wide section. It is especially necessary to endeavor to obtain the luminous heat by reflection from the walls of the dome. It is not necessary that the flames shall be in contact with the material to be melted. There is nothing gained thereby as regards utilization of the heat, and the risk is run of rendering the glass bubbly. The dome is heightened, and the hot air and the gases of combustion are often led through numerous flues arranged in superposed rows. The flames are long and the circulation is slow. There is evidently obtained a temperature less than that of steel furnaces with surbated dome, but there is no inconvenience in this, since the melting temperature of window glass reaches but 1,400° C., and is thus 200° C. less

than that of steel, which reaches 1,600° C. From another point of view, the subdivision of the flues facilitates the regulation of the temperature, which should be kept very constant. In fact, the maximum variations of such a furnace, well conducted, should not reach 50 C. in the course of a year. The installation of the gas generators of glass furnaces likewise presents special characters that result from the necessity of always maintaining the activity of the draught, despite the continual opening of the furnace doors. In a word, an endeavor is made to render the circulation of air, gas and the products of combustion easily regulatable by employing as many valves as there are flues. We shall not dwell upon the arrangement of these gas generators, but shall speak of the construction of the Gobbe glass furnace.

These first experiments did not always give satisfactory results, since in the shallow hearths that were then constructed the glass obtained was stony and the soles was attacked and thus caused numerous breakages of the walls.

What characterizes the present furnaces, especially those of window glassworks, is their great depth, which often reaches six feet or more. We shall understand how daring this arrangement (which was proposed by M. Gobbe) must have appeared at first, if we reflect



FIGS. 5, 6, AND 7.—ELECTRIC LOCOMOTIVE USED FOR VISITING THE SEWERS.

Each of these is capable of hauling five cars, and consists of a truck supporting a dynamo supplied by a battery of accumulators (Figs. 5, 6 and 7). The dynamo, which is of a very compact type, is excited in series and makes, normally, 1,600 revolutions a minute. The transmission of its motion to the axle is effected through a pinion that actuates an intermediate shaft whose velocity is reduced to 400 revolutions, and upon which is fixed a sprocket that carries along an endless chain which communicates motion to the driving axle. This latter thus has a velocity of 80 revolutions a minute, and as the wheels to which it is keyed give a development of four feet at every revolution, there is obtained a speed of 328 feet a minute, say 3.6 miles an hour.

For reversing the machine, an inverting commutator is placed in the circuit of the accumulators and of the dynamo, and permits of changing the direction of the current in the armature. The maneuver is effected by simply acting upon the handle of the commutator. The battery of accumulators is composed of 28 elements, each weighing 55 pounds. These elements are inclosed by fours in seven oak boxes placed in a chest that serves as a seat for the motorman. The total capacity of this battery is 100 ampere hours, with a mean discharge of 25 amperes under a tension of from 50 to 60 volts.

It takes but one man to run each of these locomotives. The system of towing employed for the boats is that known as towing by magnetic adhesion. A towing chain is submerged in the Asnieres collector. The train of six boats moves along this chain through the effect of two towboats, placed one in front and the other behind and operating alternately. The towboat serving to tow against the current is much more powerful than the other, and so it is upon this that is placed the source of energy, which consists of electric accumulators. These latter consist of 60 elements capable of giving a discharge of 60 amperes during two hours and a half under a tension of from 98 to 125 volts, say a capacity of 150 ampere hours. They are divided into two batteries capable of being quickly coupled in quantity or tension.

The motor consists of a dynamo making 580 revolutions a minute. Its motion is communicated to the shaft of the towing pulley by a double transmission, and, in order to prevent noise, the pinion keyed upon the shaft of the dynamo is covered with leather.

The stress to be exerted upon the towing chain by the large towboat in order to tow a complete train of boats is 1,540 pounds, at a speed of 125 feet a minute. The intensity absorbed is then 60 amperes under a tension of 65 or 68 volts, corresponding to about 4,000 watts, that is to say 5½ horse power.

The towing chain passes over three-quarters of the circumference of the magnetic pulley, which is magnetized by two bobbins keyed upon the driving shaft. Owing to such magnetization, this simple winding produces a complete adhesion of the chain upon the pulley. The adhesion of the chain upon the pulley may be rendered variable by a rheostat.

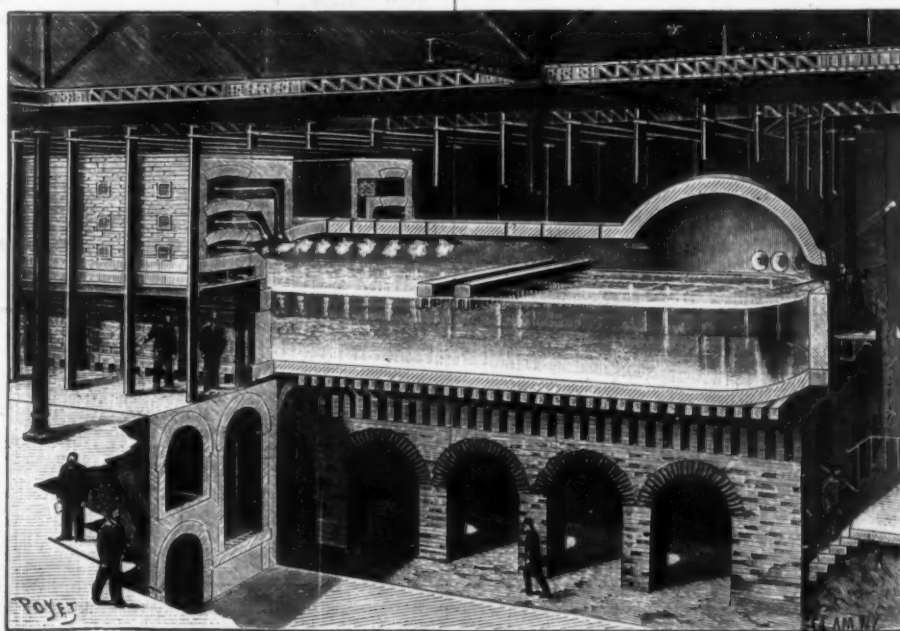
The small towboat includes only a system of wind-

that these furnaces are often 75 feet in length by 11½ in width (as is the case with the one represented in the figure), and under such circumstances contain no less than 880,000 pounds of melted glass. The escape of such a mass would produce a true disaster if the walls corroded and should happen to give way, as often occurred with furnaces of slight depth, or sometimes even when isolated pots containing but a thousand or twelve hundred pounds were employed. However surprising this consequence may seem at first sight, it appears that it is precisely the amount and especially the thickness of the mass thus brought to fusion which is the best guarantee against this grave accident of escaping melted glass. This fact finds its explanation in a study of the very conditions of heating.

When, for example, we operate upon metal in fusion, such as steel upon the hearth of the Siemens-Martin furnace, we find ourselves in the presence of a body that is a good conductor of heat, but opaque with regard to

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When, for example, we operate upon metal in fusion, such as steel upon the hearth of the Siemens-Martin furnace, we find ourselves in the presence of a body that is a good conductor of heat, but opaque with regard to



THE GOBBE FURNACE FOR THE MANUFACTURE OF WINDOW GLASS—EXTERNAL VIEW AND LONGITUDINAL SECTION.

the hearth. The lateral walls for the entire height of the molten bath are isolated from any mass of masonry. An endeavor is made, moreover, to render them easily accessible in order to permit of repairs during the course of the work. The vitrifiable materials are put into the basins through doors situated at one of the extremities of the furnace.

The glass that forms is refined in passing before the flues that lead the hot gases and flows slowly toward the holes of the working chamber situated at the opposite extremity.

Experience shows that it is impossible, whatever be the length of the furnace, to prevent the formation of impurities or scum upon the surface of the bath. It is, therefore, well to isolate, in a certain measure, the part of the furnace in which the refining is effected from the working chamber, properly so called; and, moreover, the temperatures to be kept up in the different parts of the furnace are sensibly different.

There has, therefore, been no hesitancy in forming in certain furnaces two entirely distinct compartments connected by a narrow passage and provided with special burners and registers.

In the Gobbe furnaces the apparatus has been simply elongated by suppressing the burners in the vicinity of the working holes, and floating dams are arranged for arresting the impurities upon the surface. The accompanying engraving shows that the working chamber is covered with a hemispherical dome.

In the manufacture of bottle glass there is sometimes arranged before the working hole a simple trochil perforated at the bottom, which draws up the glass from a depth of four inches and thus removes the impurities from the surface.

In the figure will be seen the arrangement of the triple row of flues of the Gobbe furnace. The gas entering through the middle flue comes between two strata of air, and this, according to the inventor, improves the combustion. These flues are all provided with independent registers that permit of regulating at will the respective draughts of air and gas.

The use of hearth furnaces has caused a profound disturbance in glass manufacture that has greatly affected the workmen and been the starting point of the troubles that this industry has been experiencing for several years.

From the standpoint of the consumption of fuel, the advantage is enormous. Mr. Darnour estimates even that the saving effected as compared with the old pot furnaces often exceeds two-thirds. This result, however, is not the most important one, and the modifications as a whole thus introduced into the work have had a still more sensible influence upon the net cost.

It must be observed, in fact, that the hearth furnace has suppressed the pots, the preparation of which necessitated a special and very costly plant. Finally, the work of handling the glass has been greatly facilitated, since, as the furnace remains continually fed, the workman operates always at a constant level.—*La Nature*.

MODERN METHODS OF IRON MINING AND SMELTING.

By WILLIAM P. KIBBEK.

IRON ores are distributed all over the globe, the chief grades being magnetic, red hematite, specular or ore, brown hematite, carbonate of iron and spathic ore.

Magnetic is the richest in the metal, and when pure contains nothing but oxygen and iron, the chemical formula being Fe_3O_4 , which generally gives 72 per cent. of iron. In the mines it occurs in heavy dark masses or crystals and is mainly found in the aged primary rocks. The Lake Superior iron district of Michigan, as also mines in Sweden, are famous for this ore.

The rock formation in which magnetic ore is found very rarely contains coal, hence it is mostly smelted with wood charcoal or coke, which, as it contains no sulphur, is one cause of the superiority of the iron produced from it.

Red hematite differs from the latter only in containing a little more oxygen, the formula being Fe_2O_3 , or 70 per cent. iron. In the several varieties of this ore attention is called to specular iron, so called from its bright metallic luster and beautiful crystalline masses. It is of a steel gray color, assuming a red tint when scratched.

Kidney ore, whose origin is still a curious problem, occurs at times in veins and again in apparently regular beds. Its characteristic form is in large kidney shaped nuggets commingled with a fine radiated structure. This shape, however, is only assumed in massive deposits where the cavities are small.

Brown hematite ore is a hydrated peroxide of iron and contains the same properties as red hematite, only that it contains about 14 per cent. water.

Brown hematite is a very important ore in Great Britain, about 3,000,000 tons being annually used by that nation.

Iron ore is still reduced in Southern Europe by the imperfect process of the Catalan forge, not unlike a common blacksmith's forge. In America and Great Britain, however, as well as all the other countries where iron is largely produced, the blast furnace is universally employed, by means of which the metal is obtained in the crude state or cast iron. For the finer kinds of iron, charcoal is the fuel mostly employed, because unlike coal or coke it contains no sulphur of iron.

As a preliminary process to the actual smelting in the blast furnace, clay and black band ironstones are roasted. This is accomplished by breaking the ore into small pieces, spreading it in heaps on the surface, and mingling it more or less with small coal according to the nature of the ore. Black band generally contains enough of carbonaceous matter to burn without the addition of coal.

The pile, which contains several thousand tons of ore, is lighted at the windward end, and gradually burns along aided by occasional fires in the sides, till the whole pile has undergone calcination. The time required for this purpose being about twenty days. Sometimes the operation of roasting is performed in close kilns instead of open piles, a method by which the ore is considered to be more uniformly roasted, and with much less fuel. By calcination clay ironstone loses from 22 to 28 and black band from 37 to 46 per cent. of its weight.

The roasting also converts the protoxide and carbonate of iron into peroxide, which prevents the formation of slags of silicate of iron, such slags, owing to the difficulty of reducing them, causing a loss of iron.

The hot blast furnace was introduced in 1830 by James B. Neilson, of Glasgow.

One engine supplies the blast to several furnaces. Air is forced into the furnace by means of the blowing cylinder, from which it passes into the receiver, and thence along a pipe into the heating oven. Here a large surface pipe is exposed, in arch-shaped rows, to the fire, which heats the inclosed air to from 600° to 1000° F. At some temperature within this range it enters into the lower part of the furnace by means of the tuyeres. Some of the engines discharge 75,000 cubic feet of air per minute, under a pressure of 3½ pounds to the square inch.

The operation of smelting is thus performed: the roasted ore, coal and lime flux are either hoisted or moved along a platform to the gallery near the top of the furnace, and fed into it at intervals through the openings in the side, when the trap is open, or by lowering a cone, when it is closed. The furnace is kept continually burning except when undergoing repairs.

The materials are raised to a very high heat, and gradually fuse into a softened mass. The clay of the ironstone then unites with the lime to form a coarse glass; the oxide of iron at the same time gives up its oxygen to the fuel, and allows the metal itself to collect on the hearth at the bottom of the furnace, united with 3 to 5 per cent. carbon, which it takes from the fuel, forming the variety called cast iron.

Every ten hours the metal is run off from the furnace by means of a tap hole at the base of the hearth into rows of parallel moulds called pigs, which are formed in sand, hence the name "pig iron." The slag, which floats on the melted iron, is run off by an opening at the top of the hearth. When the furnace is working properly, the slag should be of a light gray color; a dark brown or black shows that too much iron is passing into it.

The quantity of materials necessary to yield a ton of pig iron is as follows: 2 tons of calcined ironstone; 2½ tons coal, of which about 8 cwt. are required for the blowing engine; and from 15 to 16 cwt. of broken limestone. The proportions, of course, vary according to the nature of the ore and different districts.

The cold blast furnace is still, however, in use to a small extent in different parts of the country, and produces the toughest iron, though at a much higher cost than the hot blast. The difference in quality appears to be caused by the greater heat in the case of the hot blast facilitating the passage of impurities into the iron.

Of late years much attention has been given to plans for saving fuel in the blast furnace. Previous to the invention of the hot blast, as much as ten tons of coal were consumed for every ton of pig iron made. Even when this is brought down to 2½ tons of raw coal per ton of pig, fully three-fourths of all the heat produced is wasted in open-mouthed furnaces. The method of saving the waste gases by closing the mouth of the furnace is attended with so much economy that in the Cleveland and Pittsburgh districts alone fully 850,000 tons of coal per year are saved.

The introduction of Watt's steam engine in 1770, the processes of puddling and rolling, invented by Henry Cort in 1784, and the employment of the hot blast by Neilson in 1830 have each been great factors in the iron business. The greatest improvement introduced into the manufacture of iron is the process of Mr. Bessemer for making steel, patented in 1856.

The process consists in blowing air through molten pig iron till the whole of the carbon and silicon is removed by oxidation, and then introducing into the melted iron a given quantity of spiegelisen, which contains a known percentage of carbon.

The method of working the iron mines in the Lake Superior range is about on a line with the copper mines, except that the former occurs in massive beds of from two to four miles in length, while the latter appear in veins of uniform width and thickness, and penetrating into the earth to an unknown depth.

On the Mesaba range in Minnesota the ore is mined with immense steam shovels, which load it into cars with very little labor and small expense. The product of the Lake Superior iron mines for 1895 amounted to 10,500,000 tons iron ore. The Norrie mine in the Gogebic range, the largest iron mine in the world, heads the list of producers with a total of 900,000 tons ore to its credit.

At the close of 1895 there was shipped from the iron mines on Lake Superior an approximate total of 87,650,000 tons iron ore. The first shipment was made in May, 1857, when 2,000 tons went to Sharon, Pa., for testing purposes. Since that initial shipment the tonnage has increased till to-day Lake Superior is the greatest iron ore shipping district in the world.

The figures of production need no comment at the hands of the writer; they speak for themselves. In 1859 the total production was 23,876 tons. In 1862 the output exceeded 100,000 tons, and in 1863 amounted to 205,055 tons. The shipments for the year 1868 were 520,000 tons, and in 1873 the million mark was scored. In 1881 the output reached two million tons, and from 1886 up to 1895 the figures of production are as follows:

1886	3,569,371
1887	4,742,280
1888	5,046,503
1889	7,290,646
1890	9,000,701
1891	7,157,000
1892	9,072,241
1893	6,050,790
1894	7,755,490
1895	10,230,920

The total production of Lake Superior mines for the forty years that they have operated amounts to 87,013,920 tons. Deducting the figures of the last decade, it will be seen that 27,452,408 tons were mined the first thirty years, so that 73 per cent. of the total production has been achieved during the last ten years. It is very doubtful whether there is another business in this country that can show such a tremendous gain in so brief a period.

SELECTED FORMULÆ.

Frosted Glass with Figures.—For the production of such glass, crystal or flashed glass, no matter whether hollow or plate, is taken, the surface of which must be frosted. Upon this surface a thick, fluid solution of ordinary glue is spread. In the case of plate glass it is advisable to spread this coat about one-sixth of an inch thick, and as uniformly as possible. It is then dried at a moderate temperature of about 31 to 37 deg. C. After perfect drying the glue coat contracts and becomes cracked. The edges of these cracks turn upward and the scales of glue formed thereby show the desire to peel off. The glue having entered the pores of the frosted glass surface, the glue scales, in peeling off, carry small splinters of the frosted glass surface with them, whereby bright, shining, shell-like indentations are formed. The peeling off of the glue and the tearing off of the glass splinters connected with it takes place irregularly, sometimes in closely adjoining, longest stripes, sending out broader or narrower leaf-like branches, which form a pattern similar to fern, as is seen in the ice on a window pane. The best results of this working method are obtained in the summer, when the glass articles treated with glue are simply exposed to the rays of the sun, which cause the glue coat to peel off within three or four hours. The glue scales can be collected and dissolved by boiling in water. The glass splinters sink to the bottom, while the upper, pure solution of glue is poured off and used again. Very pretty effects are obtained with flashed plate glass, which on the flashed side must be frosted, however. The glue coat tears the flashing at some places partly, at others altogether away, whereby patterns of ice flowers on colored ground are formed. This ice flower glass is brilliantly translucent, but one cannot see through it, on account of the unevenness of the surface. Such plates can be treated on the figured side with silver or gold wash and used as mosaic to inlay in frames, furniture, etc.—*Fachblatt*.

Remedy for Frost Bite.—The following is proposed by Prof. Boeck, of Christiania:

Ichthyol	1 g.
Resorcin	1 "
Tannin	1 "
Water	5 "

This liquid, applied before retiring, with a brush, forms a varnish over the affected skin and quickly causes a reduction of the inflammatory swelling. When applied to the hands an objection is the dark discoloration of the skin, lasting nearly two weeks. It is also inapplicable for persons whose skins are irritated by resorcin. To obviate this as well as possible cracking of the skin, it is advisable to dress the part during the night with an emollient ointment. The foregoing varnish must not be applied to open frost bites.

For persons objecting to the above unsightly application for the hands, the following fair substitute may be prepared:

Resorcin	2 grammes.
Talcum	1 "
Mucilage	5 "
Camphor water	5 "

—*Western Druggist*.

How to Remove a Fixed Ring.—When a ring is fixed on the finger from the swelling of the skin or joint, rub the finger with soap and cold water, and it will then generally admit of its removal. If this fails, take a strong thread or piece of fine twine, and, beginning at the end of the finger, wind it regularly around and around it, with the coils close together, till the ring is reached; then slip the end through the ring from the side next the end of the finger, and begin to unwind the string, which, as it progresses, carries the ring with it. Sometimes, however, when the finger is very much swollen, and when the ring is deeply embedded, even this plan will not succeed, and the only resource is to cut through the ring with a pair of cutting pliers, first slipping under it a thin piece of metal or cardboard to protect the skin from injury.—*Industrial World*.

Cucumber Pomade.—Bernatzik gives the following formula:

(1.) Wax, white	3 drachms.
Spermaceti	3 "
Oil almond	7 ounces.
Cucumber juice, fresh	7 "
Extract cucumber	1 "

Another formula reads thus:

(2.) Veal suet	600 parts.
Lard	1,000 "
Cucumber juice	1,200 "
Tincture tolu	2 "
Rose water	10 "

To the liquefied suet and lard add the tolu tincture; when nearly cool gradually incorporate the cucumber juice and rose water, previously mixed, stirring constantly.—*Western Druggist*.

Chemical Guano, Grandeau.

Calcium nitrate	100
Potassium nitrate	25
Potassium phosphate	25
Magnesium sulphate	25

Dissolve from 4 to 10 grammes of this powder in 1 liter of water, and water each pot plant with this once or twice a month. The plants must be in full vegetation.—*Rev. Horticult.*

Syndeticon—Liquid Fish Glue.

Fish glue	100
Acetic acid	125
Gelatin	20
Water	125
Shellac varnish	20

Dissolve the fish glue in the acid, the gelatin in the water, mix the solutions, and then gradually incorporate the varnish.—*Sudd. Apoth. Zeit.*

Canary Bird Food.

Dried yolk of egg	2 parts.
Poppyheads pounded coarsely	1 "
Cuttlefish bone, coarsely powdered	1 "
Granulated sugar	2 "
Wheat biscuit, dried and powdered	8 "

Mix.

ENGINEERING NOTES.

A new harbor at Heysham in Lancashire, England, to take the place of that at Morecombe, is under consideration. The Midland Railway is ready to spend \$2,500,000 on it.

Tashkend will be connected with Orenburg by rail as soon as possible, the Russian government having at last selected the Orenburg route as the one that shall connect the Siberia Railroad with the Transcaspian and Samarkand line.

An international exhibition of motors is now being held at the Imperial Institute, London. The latest developments of motor carriages propelled by the agencies of oil, steam, electricity or compressed air, are shown and demonstrated, as well as the practical application of motors to tramway cars, locomotives, fire engines, street vans, omnibuses, phaetons, cabs, quadricycles, tricycles and bicycles, carriages of every kind, marine, stationary and portable motors of every description, as well as electric and other installations.

According to bureau statistics at Berlin, four-fifths of the steam engines now working in the world have been constructed during the last twenty-five years. France has 79,590 stationary and locomotive boilers, 1,850 boat boilers, and 7,000 locomotives. Germany has 59,000 land boilers, 1,700 ship boilers, and 10,000 locomotives. Austria has 12,000 boilers and 2,800 locomotives. The working steam engines of the United States represent 7,500,000 horse power, of England 7,000,000 horse power, Germany 4,500,000 horse power, France 3,000,000 horse power, Austria 1,500,000 horse power. This estimate does not include locomotives, whose number in the world is 105,000, representing a total of 3,000,000 horse power. The world's steam engines, however, aggregate more than 26,000,000 horse power, equivalent approximately to the work of 1,000,000 men.

In the railway race to Aberdeen last year the West Coast route ended by making somewhat the quicker run; and that line has hitherto led the way in the matter of train accommodation. But on the East Coast route the night express to Aberdeen has been run all winter and spring in 50 minutes less time than the West Coast; and two new trains have now been completed for the day service to Edinburgh (leaving King's Cross at 11:30 A. M.) which are a distinct advance on anything yet seen out of America. From end to end the carriages are connected by Gould vestibules. Most of the carriages have a side corridor out of which the compartments open; but one carriage is on the American plan—entered only by the ends and with the passage running down the center. It is divided into three sections, holding 23, 16, and 15 passengers respectively, the seats having their backs carried up only to the height of the passengers' heads. All through the train are bells to summon attendants, who will at any time supply tea, coffee, and other light refreshments. The trains will be heavy, and one of the new engines built for this route is probably the largest in the country. By adopting the "track tank" system, by which water is scooped up from between the rails as the train flies along, the new engine need only carry 3,000 gallons instead of 4,000 at a time, thus saving about seven tons in weight.

Respecting the railway construction in the United States in 1895, the Railway Age states that 1,803 miles were added to the mileage of the previous year as against 1,948 added in 1894 and 2,635 added in 1893. Only one of the New England States contributed to the mileage of 1895. The middle Atlantic group added 184 miles on 29 lines, the central Northern group built 285 miles on 37 lines, the ten Southern States, which are credited to the South Atlantic and Gulf and Mississippi Valley groups, added 497 miles on 54 lines, but were surpassed by the seven Southwestern States and Territories, which built 524 miles on 28 lines. Only three of the seven Northwestern States are in the list, giving 55 miles on ten lines, while in the vast region of the seven Pacific slope States and Territories only 171 miles were added by twelve lines. Texas leads all with 209 miles; Indian Territory is second with 151 miles, and Pennsylvania third with 102 miles. No other State shows as much as 100 miles. As to the prospects for railway building in 1896, it is too early to give a detailed estimate, but it may be said that the outlook is better than it was a year ago. There are between 3,000 and 4,000 miles of proposed roads on which work was in progress in 1895 or for which contracts had been let, and many thousand miles more might be counted representing legitimate undertakings which sooner or later are likely to be carried out. If the general financial situation continues to improve, as now is the common expectation, railway building will receive a decided impulse.

William Kirkaldy, a Glasgow inventor, has patented a device for closing watertight doors, a subject that has been attracting much attention among naval constructors. In describing the new contrivance, the United Service Gazette says: "The feature of Mr. Kirkaldy's patent door is its wonderful simplicity. It consists of a hollow cylindrical door, which revolves within a suitable casing fixed to, or forming part of, a watertight bulkhead. By combining this revolving cylindrical door and casing a double door is formed, which effectually prevents the ingress of fire, water, etc., through the bulkhead, yet on being revolved by hand allows free thoroughfare between watertight compartments, with the certainty that at all times and under all conditions one of the doors is absolutely closed, thus guaranteeing that the bulkhead is intact and thoroughly reliable in the event of a sudden disaster. When the doorways in casing and revolving cylindrical door are in line, free passage through bulkhead is gained by entering and standing inside of casing and revolving door by hand, when the ingress doorway in casing is absolutely closed before the doorway in revolving door comes in line with second doorway to allow egress from casing. In the event of a collision there is absolutely nothing to be done in the way of closing the watertight doors. As the doors are never open, no gearing is required to close them, thus obviating the necessity of bulkhead drill, and allowing the crew to perform other urgent work. The invention has been shown to a number of naval and engineer experts and others interested in shipping matters, who have expressed their approval of its merits and the exceptional features of safety which the door possesses."

ELECTRICAL NOTES.

Animals placed in a solenoid traversed by electric currents of high frequency, M. D'Arsonval informs the Académie des Sciences, undergo rapid respiratory changes. The currents produce carbon dioxide very rapidly in the body and ought to give relief in cases of gout, diabetes, and rheumatism, diseases in which the rate of combustion is reduced. Two cases of diabetes subjected to the currents showed great improvement.

Telephone wires seem to have an important influence in preventing lightning from striking, according to the investigations of the German telegraph department. Three hundred and forty towns with telephone systems and 500 towns without them were under observation. In the former the lightning struck three times for every hour of storm; in the latter, five times. Moreover, the violence of the lightning was much less in the former cases.

The largest automatic circuit breaker ever constructed has recently been completed by the General Electric Company. It is designed to break a circuit of 8,000 amperes and is to be used on a 100 volt circuit, although made to handle the same current at 600 or 700 volts. The studs which carry the current are $3\frac{1}{2}$ in. in diameter; the base is 28 in. square. It is constructed to open the circuit automatically at any point between 3,000 and 20,000 amperes, the opening point being arranged by the adjustment of a tension spring on the armature.

The Electrical Review, of New York, doubts if there are more than three men living who know why the standard voltage of the incandescent lamp was made 110 volts. Edison knows, and in a recent conversation the reason for the 110 volts was disclosed. The inventor, in his early work on the lamp, always allowed 10 per cent. for errors, leakage, etc., and when one of his assistants suggested 100 volts, Edison said, "We'll add 10 per cent., as usual, and make it 110 volts." That settled it, and the standard has remained the same ever since.

It is reported that recently at Budapest one of the carriages on the underground electric railway, containing six passengers, exclusive of the two railway employees in charge, suddenly took fire as it was traveling rapidly, and there was nothing to do but to quicken the speed and reach the terminus. The flames gained ground, and the car was totally destroyed soon after it reached the end of the journey. The passengers escaped with a terrible fright, but the employees were shockingly burnt. It is supposed the fire was due to some defect in the electrical apparatus.

The shipyard and engineering works which are being established at Nicolaieff, South Russia, under the auspices of the well-known Cockerill Company, of Seraing, Belgium, are not only to be lighted throughout by electricity, but all the machinery is to be driven by electromotors. In connection therewith, a large central station is being erected of a total capacity of 1,000 horse power. The plant will consist of five sets each of 200 horse power, each set comprising a multitubular boiler, a 200 horse power De Laval steam turbine, and a large Desroziers dynamo.

The work of the electrical engineer is very much in evidence in Bulawayo, which owes its present safety to the efficiency of the electrical devices adopted for its defense against the Matabeles. Within four days after it was decided to "go into laager," telephone lines were run from the main laager to the various outposts, namely, observatory, hospital, and headquarters office, and were in perfect working order. Circuits had also to be rapidly laid for the dynamite mines. These mines were necessary for the protection of the northeast and east sides of the laager, which were considered very weak on account of the formation of the ground, and the protection afforded to the enemy by the houses. The ten mines were laid from 200 to 400 yards from the center of the laager, at an angle which, while calculated to do the greatest damage to the enemy, would be the least likely to throw stones or rubbish into the laager. The mines averaged about 150 ft. long by 3 ft. wide and 2 ft. deep. The dynamite was laid in canvas along the resisting medium (electrolyte), and is, of course, measured by the product of the current and electromotive force between the copper electrodes. As this reaction is not exothermic, but absorbs energy from without, it is electrolytic and cannot take place spontaneously. In other words, two chemically pure copper plates placed in a solution of copper salt could not evolve electrical energy or constitute a galvanic cell. Similarly two zinc plates in a solution of zinc salt could not constitute a galvanic cell.—The Electrical Engineer.

An electric self-loading car has been devised, which bids fair to work a revolution in the method of cleaning the streets of large cities, says the Tradesman. It runs seven miles an hour, cleaning the whole street except a narrow strip at the sides, from which the dirt is swept toward the track, by the usual horse brooms, and it not only sweeps up the dust, but conveys it outside the city, thus saving the labor of hundreds of men and horses. The car is 22 ft. long, and is fitted with the usual trolley equipment, although the brakes, motors, etc., are all placed above the wheels and axles, so as not to impede the action of the brush. The operating platform on which the hands stand while directing the movements of the car and broom is placed to protect them from the dust thrown by the revolving brush. This brush, which makes five revolutions to each one of the car wheels, works much on the principle of a carpet sweeper. It is capable of throwing the dust a distance of 25 ft., and will pick up 38 car loads without stopping. The broom acts as well one way as another, steel deflectors being so arranged that it can be run backward without any change of machinery. The action may be reversed instantly, so as to throw the dust one way or the other, as may be desired. The broom may be extended so as to cover the whole street if necessary. For removing snow the car may be constructed long or wide, according to requirement. The car can be unloaded in thirty seconds, one man doing the whole work by lever. It is stated that the work of this machine averages less than \$1 per mile.

MISCELLANEOUS NOTES.

London society was startled on a recent Sunday by seeing half a dozen jinrickshas drawn by coolies at the church parade in Hyde Park.

A census of the Parisian café chantants has been taken. There are fifty-five of some pretensions and 219 small ones; the number of variety performers employed in them runs into the thousands.

Each instrument excels in some particular passages—the piano in scale passages, the harp in arpeggio, the mandolin in the rapid repetition of one note, the banjo in the rapid playing of broken chords, and so with other instruments, but the violin can beat them all on their own ground, while there is much violin music that can be played on no other instrument.

An ingenious device, which consists of a bunch of short tubes, and which may be fastened into the throat of a cuspidor, has been invented for the purpose of converting the latter into an umbrella stand. This would provide a convenient way of collecting the water which drips from umbrellas as people come in from the storm. In pleasant weather, the holder can be removed, and the cuspidor devoted exclusively to its own proper use.

In England pulleys are covered with leather or paper to prevent the belts from slipping. The process is as follows: the pulley is first coated with a thin layer of hot glue; the leather is then saturated upon the flesh side with a hot decoction of nutgalls, laid smooth upon the pulley, pressed on firmly and left to dry. When glued in this manner, it is said, the leather will tear before it can be stripped from the pulley. Paper, although an inferior article, may be used in the same way.

The costliness of wooden petroleum barrels, which have advanced in the last few years from 1.50 to 4.50 florins in Austria-Hungary, besides requiring repairs after long use, has induced Consul Schwimmer, in Budapest, to erect, under assistance of other capitalists, large works for the manufacture of iron barrels, welded by electricity after the latest process. These barrels will cheapen the price of petroleum, and the usual loss attending the use of wooden barrels is avoided.

It needs fifty thousand persons to make a crowd in St. Peter's, says Marion Crawford, in the Century Magazine. It is believed that at least that number have been present in the church several times within modern memory; but it is thought that the building would hold eighty thousand—as many as could be seated on the tiers in the Colosseum. Such a concourse was there at the opening of the Ecumenical Council in December, 1869, and at the two jubilees celebrated by Leo XIII; and on all three occasions there was plenty of room in the aisles, besides the broad spaces which were required for the functions themselves.

English temperance drinks have a large proportion of alcohol, according to recent testimony before the Liquor Commission. Of 638 samples of herb beer examined in 1894 by the Inland Revenue Department, 314 contained more than two per cent. of proof spirit and 130 more than three per cent. Parsnip beer was found to contain over 13 per cent., which is much stronger than ordinary beer. "Teetotal sherry," containing no grape juice, but compounded of sugar and bisulphide of lime, is declared to be a "most objectionable drink." A startling expert declaration was that old whisky, though more grateful to the taste, is no more wholesome than new.

The German city of Cologne, one of the great industrial centers of the Teuton empire, deserves the credit of having inaugurated an altogether new system of insurance, namely, that against winter want. The main object of the scheme is to provide funds by means of insurance for the support of the working classes during periods of depression in trade and want of employment. The institution, which is proving very successful, is now receiving not only the moral but also the financial support of the state and communal authorities, who heartily appreciate the work which it has already accomplished in bringing about a decline of destitution and pauperism.

A curious method of producing platinum is practiced by the inhabitants of the villages on the Tura River, in the Russian government district of Tomsk, in Siberia. They call this method "plowing the water." A raft is constructed and an inclining gutter of boards fastened to it, which at its lower end is provided with an iron plow. While floating down the river they scrape or plow its bottom. The sand scraped out falls into the gutter and passes into a tub filled with pine boughs, upon which platinum is deposited. The sand of the Tura River and its tributaries is so rich in platinum and its primitive production so profitable that the peasants are abandoning agriculture and devoting themselves to "plowing the water."

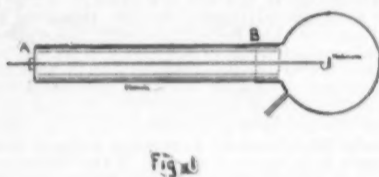
A gorgeously illustrated edition of the Bible is being prepared at Amsterdam, which will be printed with English, French, German, and Dutch text. Walter Crane will furnish the cover and pictures for the first thirteen chapters of Genesis, except the creation, which will be done by Sir E. Burne-Jones, Gerôme, Morot, James Tissot, Alma-Tadema, and Jean Paul Lorenz will illustrate the rest of the Pentateuch and the Book of Ruth. Benjamin Constant, Joseph Israels, and John T. Sargent, Samuel and the story of David; Frank Dicksee, Wenzel Brozik, and Max Klinger, Kings and Solomon; Hebert, Domenico Morelli, and Munkacz, the New Testament. Prof. Duke, of the Amsterdam Academy of Arts, is the director of the work.

Warnings have just been issued almost simultaneously by the leading medical societies of Paris, Berlin and Vienna against the evils of excessive coffee drinking, which are declared to be second only to those of alcoholism. Indeed, the symptoms of coffee drunkenness are so similar to ordinary inebriety that physicians constantly diagnose coffee poisoning as alcoholic disturbance. Years ago the beverage was generally a forbidden one for children, but nowadays coffee is drunk as much by boys and girls as by their elders. Insomnia, nausea, depression of spirits and lack of appetite are among the symptoms of coffee poisoning, and the effort on the part of a confirmed coffee drinker to become a total abstainer is similar in result to that which follows the abandonment of alcoholic liquors, the nervous system being terribly wrenched.

NEW FORM OF APPARATUS FOR THE PRODUCTION OF ROENTGEN RAYS.

SOME time in the month of March, this year, after working with various forms of tubes, it occurred to the writer to abolish the glass vessel by converting the ordinary concave cathode into a nearly complete sphere, with the platinum anode at its center. A simple experiment with a Jackson bulb proved that the rays from the cathode could pass through the material of the cathode as they would through a similar piece of unelectrified aluminum placed outside the bulb. Hence it became fairly evident at the outset that the proposed plan would work to some extent.

Under the guidance of Prof. Lodge, and in his research laboratory, experiments were commenced. The first arrangement was a simple one. The sphere was made in two halves, one half of copper and the other of aluminum. The two halves were joined together with marine glue only. The anode was held in position by ebonite fixed in the copper hemisphere. A section of this simple arrangement is shown in Fig. 1. The section is drawn to scale, the diameter of the sphere being 2 inches. This early apparatus showed signs of success, and it was decided to invest in a larger sphere—one of 3½ inches in diameter. The joints were now made much more carefully, and the apparatus so designed that it could be fitted together or taken to pieces in half an hour's time. The hemispheres of copper and aluminum were soldered together, but the joints (A and B, Fig. 1) were made by compressing India rubber washers by means of suitably made screws. With this convenient apparatus the behavior of various sizes and shapes of anodes was observed. In all the experiments a small thick plate of platinum, having a plane surface of about ¼ square inch, was re-



served for that portion of the anode which received the cathode rays; the remainder of the anode was sometimes of aluminum and sometimes of copper. The various forms tried are shown in Figs. 2 to 8.

In Fig. 2 we have the simplest possible anode—the platinum plate alone. It is the same arrangement as that of Fig. 1, the only difference being that of dimensions. This form possessed an enormous resistance, so that only with low vacua could a current be made to pass through. For this reason the behavior of this form was unsteady and its periods of activity very short. With higher vacua and greater potentials, no doubt this form would be more successful. Another form tried was that shown in Fig. 3. The anode here was very considerably enlarged by placing a circular plate of metal just behind the platinum, at a place where no cathode rays could fall on it. By this means the area of the anode surface was increased sixteenfold approximately. The resistance was thereby much reduced, and it became possible to work at higher vacua. This form gave a more powerful and a considerably more uniform radiation than that of its predecessor.

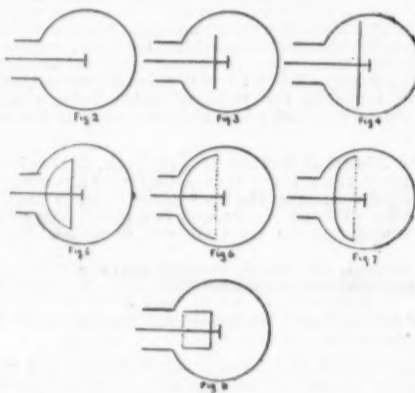
The next step was to increase still further the area of the anode (see Fig. 4). The anode now nearly filled the sphere. The result, however, was not so good, tending to show that the best size of anode is something less than Fig. 4, and greater than Fig. 2; but Prof. Lodge thinks that this is a question of the particular vacuum employed. Another differently shaped anode was next tried. This was formed of a metallic hemisphere with a flat plate in front of it (see Fig. 5). The idea was to get all, or nearly all, of the electric discharge, and so possibly most of the cathode radiation also, to

to see very small objects in. But the hand, when placed between the screen and the timber, cast no shadow whatever.

The next observation on the power of the radiation was to take the screen to a distance of 30 feet from the source. At this distance the bones of the hand could be seen, but not the flesh. Even the bones cast no deep and sharp shadows at this distance, not owing to lack of fluorescence—for the screen was really bright—but owing probably to the turbidity of the intervening 30 feet of air.

The source was afterward placed in position at one end of the laboratory, and the screen taken to the opposite end, or rather to the end of the corridor leading to the laboratory, a distance of 62 feet from the source. Even here the screen fluoresced with some energy, but the hand was observed to cast no perceptible shadow. When this apparatus was working, there was no place within the large room where the screen did not fluoresce, the rays passing through masses of timber and tables with surprising penetration.

This experimental tube, however, with its rubber joints and ebonite insulation, is not a lasting concern.



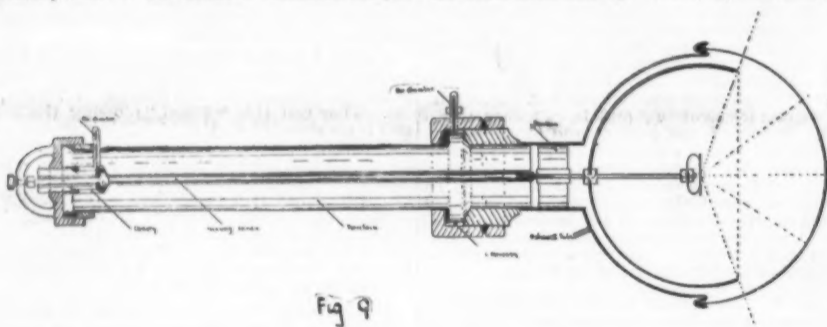
Although a good vacuum can be maintained for hours together when not in work, it will not last more than half an hour or so when in continuous use, after which more pumping is necessary. The current evidently produces some change in the rubber and ebonite, disengaging a gas which slowly destroys the vacuum.

In the final instrument the joints are of mercury, and the insulation of porcelain. The joints are first ground and polished and then flooded with mercury. Except the porcelain, the entire apparatus can be made in the lathe, which is a great consideration. A longitudinal section of the instrument is given in Fig. 9. At the end of the porcelain is an arrangement for focusing, which can be manipulated while the instrument is working, so that a point source can be obtained definitely and easily by trial. This figure, which is reproduced from an early picture, has a spherical anode. This should be replaced by a circular plate resembling the anode of Fig. 3.

This last form of instrument, though designed in the middle of May, has not yet been built, owing to the delay in manufacturing the various parts. The parts are easily enough made, but manufacturers seldom care to attend to single articles except at their own convenience.

In conclusion it may be stated, though it is unnecessary to do so, that the instrument just described owes its existence to the teaching of Prof. Lodge.—Benjamin Davies, in Nature.

To get the cores entirely removed from small brass castings is difficult, and tumbling does not always do the work satisfactorily. Here, says a correspondent, is



take place between the outer aluminum hemisphere and the anode. The idea probably is a crooked one; anyhow, this form proved less successful than others. The plate was next removed and the hemisphere was replaced by a larger one, as in Fig. 6. For some unknown reason this form gave no radiation whatever, although the vacuum was fairly high. The resistance, however, was low. The experiment was not really a successful one, for there arose some trouble from either small leakages or vapor pressures. The next form was Fig. 7. This gave really bright flashes on a sensitive screen, and the resistance was low. Still another form is that of Fig. 8. The anode now is a hollow cylinder with one end open. The total area of this anode is considerably greater than that of Fig. 3, but the latter gave much the more powerful radiation. It appears, therefore, that both the size and the shape of the anode have an important influence on the radiating power of the apparatus.

The form which gave the most powerful radiation was that of Fig. 3. This sent a powerful radiation through 3 feet of timber. The rays on emerging were received on a fluorescent screen made of about fifteen shillings' worth of potassium platino-cyanide, and the area of which was 36 square inches. This screen was considerably affected by the rays after having traversed the 3 feet of timber, and gave sufficient light

an idea that is worth trying, as it has been worked successfully in one place. It should be added, however, that it is only applicable to brass. Before the casting is perfectly cold dip it into water, and the steam formed on the surface of the metal will blow off every particle of sand and leave the casting as fresh and clean as though its interior had been made into a tumbler and run until it was worn bright. It will not do to be careless in the handling, since if the metal is plunged in too hot it is apt to be softened or cracked; but after a short experience the scheme can be worked as a great labor saver.

Sir Edward Bunbury's magnificent collection of Greek coins was sold for over \$42,000 in an eight days' sale lately in London. Among the highest prices were \$995 for a Syracuse demaration of 450 B. C., with a head of Nike, crowned with olive, commemorating the great victory at the Himera, the rarest of Greek coins; \$600 for a dekadrachm of Kimon, with a head of Persephone; \$605 for a stater of Ellis, having on it an eagle with a hare in its claws. A tetradrachm with a head of Arethusa, brought \$402; a gold stater of Tarentum, with the head of Demeter, \$350; a tetradrachm of Thurii, with head of Athena, having her helmet adorned with the figure of Skylla, \$535; one of Agrigentum, with two eagles standing over a supine hare, \$450.

T H B

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TABLE OF CONTENTS.

	PAGE
I. ANTHROPOLOGY.—The Emblematic Use of the Tree in the Iroquois Group.—By ALICE C. FLETCHER.—A valuable paper by a recognized authority, as read at the A. A. S. meeting, Buffalo, 1896.—First installment.	17241
II. ASTRONOMY.—The Eclipse of the Sun.—Popular account of the recent total eclipse of the sun as seen in Norway.	17241
III. CHEMISTRY.—The Quantitative Analysis of Metals by Electrolysis.—Simple apparatus for carrying out the above named process.—3 illustrations.	17246
IV. CYCLING.—Akroyd's Cells for Pneumatic Tires.—A tire which can stand many punctures before deflation.—3 illustrations.	17246
V. ELECTRIC ENGINEERING.—Double Crowley Gas Engine and Direct Driven Dynamo.—A direct connected gas engine and dynamo.—1 illustration.	17247
VI. ELECTRIC LIGHTING.—Railway Trains Abroad.—The field of electric lighting abroad.—A very full review of this subject.	17248
VII. ENTOMOLOGY.—The Young Entomologist and What He Wants.—By SAMUEL H. SCUDDER.—An excellent practical article on the beginner's work in entomology.—The collection and preservation of insects.	17249
VIII. HISTORY OF SCIENCE.—Machine for Raising Water from a River to the Height of a Half Diameter of a Large Wheel, with but Slight Pressure.—A curiosity in the history of mechanics.—1 illustration.	17249
IX. HYGIENE.—Sunstrokes.—A theory of sunstroke and experiments to test its truth.	17250
X. METALLURGY.—Modern Methods of Iron Mining and Smelting.—By WILLIAM P. KIRBY.—Notes on iron, iron ore and methods of working the same.	17250
XI. MISCELLANEOUS.—The Trouble in Crete.—An interesting article on Crete, its products and history; and story of the present crisis.—4 illustrations.	17250
THE BRUSSELS INTERNATIONAL EXHIBITION OF 1897.—Prospects of the exhibition, with plans of the buildings and grounds.—1 illustration.	17250
THE ART OF BRONZE CASTING IN EUROPE.—By GEORGE SIMONDS.—A very practical description of the methods of testing bronze statues.—First installment.	17250
SELECTED FORMULAE.	17252
ELECTRICAL NOTES.	17253
MISCELLANEOUS NOTES.	17253
XII. NUMISMATICS.—English Coins.—By G. F. HILL.—Early English, Scottish and Irish coins, with numerous representations.—1 illustration.	17254
Note on a Recent Sale of Greek Coins in London.	17254
XIII. PHYSICS.—New Form of Apparatus for the Production of Roentgen Rays.—A new X ray tube giving powerful radiations.—3 illustrations.	17254
XIV. RAILROAD ENGINEERING.—The Sneffels Mountain Railway.—An electric railroad operated on the Isle of Man.—Description of equipment and roadbed traversed.—3 illustrations.	17257
XV. SOCIAL SCIENCE.—An Industrial Democracy.—An interesting experiment by an American manufacturing company, establishing popular relations between labor and capital in their factory.	17258
XVI. TECHNOLOGY.—Milk and Some of its Products.—By JOHN CROWELL.—The quality of milk and the preparation from it of condensed milk, cream, butter, etc.—The new type of furnace now used for the manufacture of glass, displacing the old pot furnace.—1 illustration.	17259

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